Enterprise Resource Planning: Global Opportunities & Challenges

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This text offers a present-day analysis of ERP systems, cultural factors, and prospective method variations for organizations of all sizes.

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Enterprise Resource Planning—Global Opportunities & Challenges

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Preface

This book provides a socio-technical view of enterprise resource planning (ERP) selection and implementation practices from a global perspective. The emphasis of this book is not on the technology per se but on the selection, implementation strategies, as well as implications of ERP systems towards organizational effectiveness. It covers critical examination of the usefulness of ERP systems' functionality assessment for small-to-medium-sized enterprises (SMEs), effective use of ERP for achieving organizational effectiveness, and ERP for supporting the knowledge management functions in organizations. Case studies together with some empirical investigation of ERP systems utilization in organizations covering countries such as the US, UK, Sweden, Austria, Australia, New Zealand and Philippines are provided.

In particular, this book provides: (i) global coverage highlighting case studies and empirical studies of the ERP practices covering both the developed and developing economies; (ii) interdisciplinary focus to improve understanding of the business benefits and myths of the effectiveness of ERP systems; (iii) coverage of different investigative approaches such as case studies, empirical studies, interpretative studies, action research and ethnographic studies as a paradigm of research towards understanding ERP systems' functionality, selection, implementation and post-implementation issues; (iv) socio-technical view of the utilization of ERP systems in both large and small-to-medium-sized organizations; and (v) materials that can be used for business case studies and teaching.

Chapter 1 provides a historical perspective of the evolution of ERP systems and its overall trend in the industry. The chapter highlights useful ERP concepts such as characteristics and software architecture of ERP systems, major ERP vendor options for extended and Internet-enabled ERP systems, and global ERP trends, opportunities and challenges. It also highlights critical issues related to the management of the ERP life cycle.

Chapter 2 discusses the myth of ERP systems integration. This research examines the implementation process of an Enterprise Resource Planning (ERP) system and shows that implementation cannot be viewed solely in instrumental terms–that is, organizations do not simply select systems based on information requirements so that proper "fit" can be achieved. Instead, this research suggests that the activities of selecting and implementing a new ERP become the medium for (re-) constructing or (re-) constituting the organization's values. Theorists have described such activities as a "mythmaking" process. A case study of an implementation at a large nonprofit organization is presented to demonstrate how mythmaking served to construct an ERP system as an "integrated" system and at the same time served to elaborate existing organizational values. The myth functioned as a vehicle of consensual organizational reality, serving to align the acquisition of an ERP system with the organizational values, thereby garnering widespread support for a complex, expensive and relatively unknown technology.

Chapter 3 addresses the rationale for adoption of ERP systems in universities. This chapter outlines the significance of Enterprise Resource Planning (ERP) systems and analyses the rationale used for their adoption. This study is structured around the theory of motivations for investment in information technology (IT) to support core business operations. The data used for the study are documents published electronically on the Internet by universities. A content analysis was applied to this data. The chapter employs frequent use of quotes from the sources selected to assist the reader to

understand the context and to verify the analysis. The findings are that the main reasons for adopting ERP are the modernization of systems, greater usability and flexibility, integration of data and systems, business process reengineering, an increase in the degree of electronic data interchange including the provision of Web-based interfaces to application systems, reduced maintenance and risk avoidance.

Chapter 4 provides an assessment of ERP systems adoption in the Philippines. Viewed as a valuable resource that can provide various capabilities to companies that use it, ERP can be a source of competitive advantage for a firm. However, the successful adoption of ERP will require culture modification within a firm as it involves revolutionary changes in the way people will be doing things, especially in developing countries like the Philippines. This modification raises some issues that point to the viability of ERP's use in the Philippine context. This chapter presents an overview of ERP adoption in the Philippines by examining four Philippine business enterprises as case studies. These firms are part of global enterprises with parent companies abroad. The chapter investigates the organizational context within which ERP is applied in the Philippine setting. It also looks at the problems and issues raised by the said firms in their use of ERP as a tool to achieve efficiency in the organization.

Chapter 5 discusses the impact of ERP systems on organizational effectiveness in Sweden. Enterprise Resource Planning (ERP) systems have an organizational impact and are in most cases implemented to improve organizational effectiveness. Shortcomings in current research make it difficult to conclude how an organization may be affected. This paper presents an artifact evaluation of the functionality and perceived benefits of ERP systems. The evaluation is based on the competing values model. The evaluation shows that ERP systems support effectiveness criteria (such as control and productivity) related to internal process and rational goal models. The evaluation also points out weaknesses in ERP systems and especially in areas related to human relations and open systems models. The result of the evaluation is used to discuss the impact of ERP systems on organizations and is presented as a series of hypotheses.

Chapter 6 provides an empirical investigation of the usefulness of ERP and knowledge management (KM) systems for enhancing organizational efficiency and flexibility. The chapter compares the characteristic differences and similarities between the two initiatives and examines how they influence organizational efficiency and flexibility when implemented within a global engineering firm. It is suggested that the two initiatives are conceptually complementary and can only create a synergy when the design of organizational routines and practices fits into the meta-routines imposed by ERP and KM, and the social processes are nurtured within functions and cross-functionally.

Chapter 7 discusses the knowledge management process for enterprise systems. Enterprise Systems are comprehensive and complex applications that form the core business operating system for many companies worldwide and throughout most industries. The selection, implementation, use and continuous change and evolution of enterprise systems (ES) require a great amount of knowledge and experience. Empirical studies show that the management of knowledge is one of the main cost drivers of ES projects. Consequently, organizations have realized the need to better leverage their Knowledge Management for Enterprise Systems. This chapter proposes a framework for structuring knowledge for Enterprise Systems. A three-dimensional framework is derived from meta-case studies and comprehensive literature analysis. It consists of dimensions for the ES life cycle, the Knowledge Management life cycle and the types of knowledge. Preliminary empirical insights show that especially the lack of product-

specific knowledge is a critical success factor that leads to significant consulting costs in ES projects.

Chapter 8 presents a case study of an overview of the efforts of Texas Instrument's (TI's) internal and external ERP implementation, with a focus on linking its ERP system in a global e-commerce setting. It is argued in this chapter that this linkage is especially important since it had been stated in TI's strategic plan as an objective of this project to provide visibility of the ERP system to external environment via Web linkages along with the objective of standardizing internal processes and important IT to support market needs.

Chapter 9 introduces an object-oriented awareness-based methodology for ERP. This chapter introduces a conceptual model for ERP that has an emphasis on the collaborative nature of the ERP process that explicitly addresses the "awareness" and "knowledge-sharing" issues within the ERP process. This conceptual model demonstrates the collaboration requirements of the actors behind individual business processes as well as the relationships among these business processes. This chapter is intended to introduce to the ERP community a relevant piece of work in conceptual modelling from the perspective of computer supported collaborative work (CSCW) with the aim of attracting research collaborators for further investigation in these fields. Like many existing ERP frameworks/models, the proposed framework is also based on a widely accepted assumption that a corporate-wide information system consists of a set of potentially related subsystems. As a result, information flows among these subsystems must be identified and required resources be planned using an appropriate ERP methodology.

Chapter 10 introduces a framework for assessing ERP systems' functionality for the SMEs in Australia. Anticipating the use of the ERP systems among the SMEs to be the future area of growth, ERP vendors such as SAP, Oracle, PeopleSoft, J. D. Edwards and Baan are introducing ERP software that appeals to the market segment of the SMEs. Introduction of the ERP systems for SMEs includes compact packages, flexible pricing policies, new implementation methodologies, and more specialised functionalities. The strengths-weakness-opportunity-threats (SWOT) framework of the ERP software offered by the aforementioned vendors for the SMEs requires in-depth analysis based on real field data. This study attempts to identify the strengths, weaknesses, opportunities, and threats of ERP systems offered by the five leading vendors for the SMEs in Australia. Multiple case study design approach is used here for collecting the primary data from the ERP vendors. A SWOT framework is developed to study the functionality of the ERP systems offered by these vendors. This framework may guide the managers of SMEs in selecting and implementing ERP systems for their organizations.

Chapter 11 describes the implementation process of an ERP system at Alimentos Peru. It discusses the organization's major concerns during the mid-1990s, including increasing competition, inefficiency of business processes, and lack of timely and accurate information. The study explains the criteria used to evaluate and select the system, as well as the main issues and problems that arose during the implementation process. In particular, this case focuses upon a set of implementation factors, such as top management support, user participation, and project management.

Chapter 12 provides a framework for the selection of ERP packages for small- to-medium and large organizations. The focus here is on the early stage of evaluating and selecting an ERP system prior to implementation. Only a part of the decision making for ERP systems can be handled by a definite or accepted procedure such as standard

investment calculations. There are many other intangible decision-making criteria needed to be judged and evaluated by the decision makers. There is no agreed-upon and formal procedure for this important task. Therefore it seems necessary to investigate decision-making practices to increase the understanding of this complex and important task. The chapter also focuses on the decision-making situation faced by small and medium-sized enterprises (SMEs). This is of particular importance because SMEs are more and more experiencing the need for integration, especially for interorganizational integration, and expecting ERP software to fulfill these needs. The availability of relatively inexpensive hardware is fostering this situation. In general, decision making in SMEs features much greater constraints on the ability to gather information in order to reduce uncertainty about their investment. Considering ERP software decisions with its complex and far-reaching implications, poor decision making by SMEs can result in disastrous situations. The framework outlined in this chapter and the investigated research hypotheses represent a further step towards understanding the decision-making process for ERP investments and differences made by SMEs and large organizations.

Chapter 13 provides an exploratory investigation of the Enterprise Resource Planning (ERP) software selection process in New Zealand. A brief background together with the main features of ERP is provided. It is conferred in this study that the selection and implementation of ERP deserve equal importance. Findings of exploratory case studies on the ERP selection process in New Zealand (NZ) suggest that the selection of ERP guides the implementation process. It is also evident from findings of the study that most New Zealand organizations select their consultants and let them guide the ERP selection, implementation, as well as post-implementation process.

Chapter 14 shows how cost benefit analysis can be applied to large-scale ERP projects, and that these methods can incorporate the intangible benefits, e.g., user satisfaction. Detailed information on the business case utilized by a large computer manufacturer in their decision to implement the SAP system R/3 is also presented here.

Chapter 15 addresses the issues associated with the use of external expertise in enterprise systems. It looks at the ES implementation life cycle and identifies where in the implementation process external experts are utilized and what roles they fulfill in the implementation project. The paper concludes with a New Zealand case experience illustrating the use of external experts in a major enterprise systems implementation.

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November 2001

Chapter I: The Evolution of ERP Systems: A Historical Perspective

OVERVIEW

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ERP systems are now ubiquitous in large businesses and the current move by vendors is to repackage them for small to medium enterprises (SMEs). This migration has many consequences that have to be addressed through understanding the history and evolution of ERP systems and their current architectures. The advantages and disadvantages of the ERP systems will impact their penetration in this new market. The market position and general strategy of the major systems providers in preparation for this push are described. The chapter concludes that the growth and success of ERP adoption and development in the new millennium will depend on the legacy ERP system's capability of extending to Customer Relationship Management (CRM), Supply Chain Management (SCM) and other extended modules, and integration with the Internet-enabled applications.

INTRODUCTION

The unprecedented growth of information and communication technologies (ICT) driven by microelectronics, computer hardware and software systems has influenced all facets of computing applications across organizations. Simultaneously the business environment is becoming increasingly complex with functional units requiring more and more inter-functional data flow for decision making, timely and efficient procurement of product parts, management of inventory, accounting, human resources and distribution of goods and services. In this context, management of organizations needs efficient information systems to improve competitiveness by cost reduction and better logistics. It is universally recognized by large and small-to- medium-size enterprises (SME) that the capability of providing the right information at the right time brings tremendous rewards to organizations in a global competitive world of complex business practices.

Starting in the late 1980s and the beginning of the 1990s new software systems known in the industry as enterprise resource planning (ERP) systems have surfaced in the market targeting mainly large complex business organizations. These complex, expensive, powerful, proprietary systems are off the-shelf solutions requiring consultants to tailor and implement them based on the company's requirements. In many cases they force companies to reengineer their business processes to accommodate the logic of the software modules for streamlining data flow throughout the organization. These software solutions, unlike the old, traditional in-house-designed company- specific systems, are integrated multi-module commercial packages suitable for tailoring and adding "add-ons" as and when required.

The phenomenal growth of computing power and the Internet is bringing ever more challenges for the ERP vendors and the customers to redesign ERP products, breaking the barrier of proprietorship and customization, and embracing the collaborative business over the intranet, extranet and the Internet in a seamless manner. The vendors already promise many "add-on" modules, some of which are already in the market as a sign of acceptance of these challenges by the ERP vendors. It is a never-ending process of reengineering and development bringing new products and solutions to the ERP market. ERP vendors and customers have recognized the need for packages that follow open architecture, provide interchangeable modules and allow easy customization and user interfacing.

ERP SYSTEMS DEFINED

Enterprise resource planning systems or enterprise systems are software systems for business management, encompassing modules supporting functional areas such as planning, manufacturing, sales, marketing, distribution, accounting, financial, human resource management, project management, inventory management, service and maintenance, transportation and e-business. The architecture of the software facilitates transparent integration of modules, providing flow of information between all functions within the enterprise in a consistently visible manner. Corporate computing with ERPs allows companies to implement a single integrated system by replacing or re-engineering their mostly incompatible legacy information systems. American Production and Inventory Control Society (2001) has defined ERP systems as "a method for the effective planning and controlling of all the resources needed to take, make, ship and account for customer orders in a manufacturing, distribution or service company." We quote several definitions from the published literature to further explain the concept: "ERP (enterprise resource planning systems) comprises of a commercial software package that promises the seamless integration of all the information flowing through the company–financial, accounting, human resources, supply chain and customer information" (Davenport, 1998). "ERP systems are configurable information systems packages that integrate information and information-based processes within and across functional areas in an organization" (Kumar & Van Hillsgersberg, 2000). "One database, one application and a unified interface across the entire enterprise" (Tadjer, 1998). "ERP systems are computer-based systems designed to process an organization's transactions and facilitate integrated and real-time planning, production, and customer response" (O'Leary, 2001). The concept of the ERP system can be illustrated, following Davenport (1998), with the diagram in Figure 1.

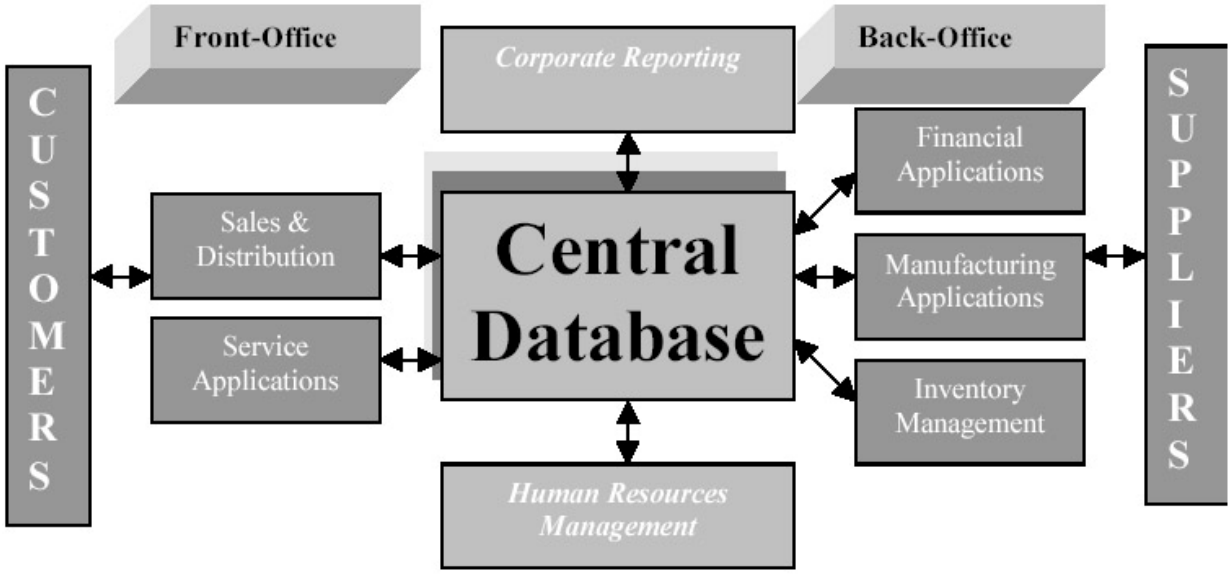

Figure 1: ERP systems concept

EVOLUTION OF ERP SYSTEMS

The evolution of ERP systems closely followed the spectacular developments in the field of computer hardware and software systems. During the 1960s most organizations designed, developed and implemented centralized computing systems, mostly automating their inventory control systems using inventory control packages (IC). These were legacy systems based on programming languages such as COBOL, ALGOL and FORTRAN. Material requirements planning (MRP) systems were developed in the 1970s which involved mainly planning the product or parts requirements according to the master production schedule. Following this route new software systems called manufacturing resources planning (MRP II) were introduced in the 1980s with an emphasis on optimizing manufacturing processes by synchronizing the materials with production requirements. MRP II included areas such as shop floor and distribution management, project management, finance, human resource and engineering. ERP systems first appeared in the late 1980s and the beginning of the 1990s with the power of enterprise-wide inter-functional coordination and integration. Based on the technological foundations of MRP and MRP II, ERP systems integrate business processes including manufacturing, distribution, accounting, financial, human resource management, project management, inventory management, service and maintenance, and transportation, providing accessibility, visibility and consistency across the enterprise.

During the 1990s ERP vendors added more modules and functions as "add-ons" to the core modules giving birth to the "extended ERPs." These ERP extensions include advanced planning and scheduling (APS), e-business solutions such as customer relationship management (CRM) and supply chain management (SCM). Figure 2 summarizes the historical events related with ERP.

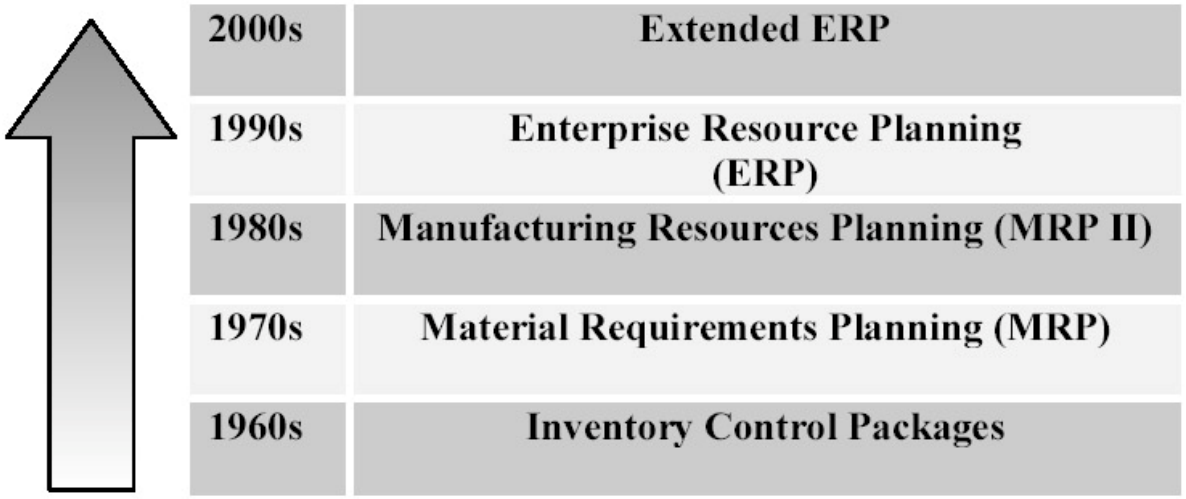

Figure 2: ERP evolution

ERP SYSTEMS AND ORGANIZATIONS

It is generally a misleading perception that implementing an ERP system will improve organizations' functionalities overnight. The high expectation of achieving all-round cost savings and service improvements is very much dependent on how good the chosen ERP system fits to the organizational functionalities and how well the tailoring and configuration process of the system matched with the business culture, strategy and structure of the organization. Overall an ERP system is expected to improve both backbone and front-end functions simultaneously. Organizations choose and deploy ERP systems for many tangible and intangible benefits and strategic reasons. In many cases the calculation of return on investment (ROI) is weighted against the many intangible and strategic benefits. The benefits that an industry standard ERP system may bring to organizations are shown in Table 1. To reap the benefits of ERP systems, however, organizations need to over- come certain problems and disadvantages, which are listed in Table 2.

Table 1: Advantages of ERP systems

What benefit	How
Reliable information access	Common DBMS, consistent and accurate data, improved reports.
Avoid data and operations redundancy	Modules access same data from the central database, avoids multiple data input and update operations.
Delivery and cycle time reduction	Minimizes retrieving and reporting delays.
Cost reduction	Time savings, improved control by enterprise-wide analysis of organizational decisions.
Easy adaptability	Changes in business processes easy to adapt

Table 1: Advantages of ERP systems

What benefit	How
	and restructure.
Improved scalability	Structured and modular design with "
Improved maintenance	Vendor-supported long-term contract as part of the system procurement.
Global outreach	Extended modules such as CRM and SCM.
E-Commerce, e-business	Internet commerce, collaborative culture.

Table 2: Disadvantages of ERP systems

Disadvantage	How to overcome
Time-consuming	Minimize sensitive issues, internal politics and raise general consensus.
Expensive	Cost may vary from thousands of dollars to millions. Business process reengineering cost may be extremely high.
Conformity of the modules	The architecture and components of the selected system should conform to the business processes, culture and strategic goals of the organization.
Vendor dependence	Single vendor vs. multi-vendor consideration, options for "best of breeds," long-term committed support.
Features and complexity	ERP system may have too many features and modules so the user needs to consider carefully and implement the needful only.
Scalability and global outreach	Look for vendor investment in R&D, longterm commitment to product and services, consider Internet-enabled systems.
Extended ERP capability	Consider middle-ware and extended modules SCM.

It was estimated that the spending on ERP systems in 1998 was about US$17 billion following annual growth rates ranging from 30% to 50%. Companies also spend a multiple of licensing costs on services related to implementation and maintenance of the software. The worldwide license and maintenance revenue for ERP systems was US$21.5 billion in 2000, which represented a growth of 13.1% from the 1999 market value of $US19 billion (Broatch, 2001). The continued growth of the ERP systems market is attributed to the fact that the vendors are adding applications such as supply chain management, customer relationship management and the integration of Internet-enabled applications for e-business.

More than 60% of the Fortune 1000 companies have installed or are in the process of implementing packaged ERP systems to support their back-end business activities (Kraft, 2001). These packages implemented by the Fortune 1000 companies run well over the IT budgets for most SMEs. ERP vendors are targeting this untapped SME market with supposedly scaled-back systems suitable for smaller firms by offering simple, cheaper and pre-configured easy-to-install solutions within budget and time constraints. For some vendors this may lead to offering centrally managed Internet-enabled ERP-system-based services for SMEs to access and use anytime from anywhere.

ERP SYSTEMS ARCHITECTURE

ERP vendors, mostly experienced from the MRP and financial software services fields, realized the limitations of the old legacy information systems used in large enterprises of the 1970s and 1980s. Some of these old systems were developed in-house while others were developed by different vendors using several different database management systems, languages and packages, creating islands of noncompatible solutions unfit for seamless data flow between them. It was difficult to increase the capacity of such systems or the users were unable to upgrade them with the organization's business changes, strategic goals and new information technologies.

An ERP system is required to have the following characteristics:

- Modular design comprising many distinct business modules such as financial, manufacturing, accounting, distribution, etc.
- Use centralized common database management system (DBMS)
- The modules are integrated and provide seamless data flow among the modules, increasing operational transparency through standard interfaces
- They are generally complex systems involving high cost
- They are flexible and offer best business practices
- They require time-consuming tailoring and configuration setups for integrating with the company's business functions
- The modules work in real time with online and batch processing capabilities
- They are or soon they will be Internet-enabled

Different ERP vendors provide ERP systems with some degree of specialty but the core modules are almost the same for all of them. Some of the core ERP modules found in the successful ERP systems are the following:

- Accounting management
- Financial management
- Manufacturing management
- Production management
- Transportation management
- Sales & distribution management

- Human resources management
- Supply chain management
- Customer relationship management
- E-Business

The modules of an ERP system can either work as stand-alone units or several modules can be combined together to form an integrated system. The systems are usually designed to operate under several operating platforms such as UNIX, MS Windows NT, Windows 2000, IBM AIX, and HP-UX systems. SAP AG, the largest ERP vendor, provides a number of modules with its famous R/3 ERP system, which are shown in Table 3. New modules are introduced by SAP and other vendors in response to the market and technological demand such as the Internet technology.

Table 3: Some of the modules of SAP's R/3

Financial Accounting	**FI**	**Controlling**	**CO**	**Asset Management**	**AM**
Project System	PS	Workflow	WF	Industry Solutions	IS
Human Resources	HR	Plant Maintenance	PM	Quality Management	QM
Production Planning	PP	Materials Management	MM	Sales & Distribution	SD
Investment Management	IM	Enterprise Controlling	EC	Treasury	TR
Modules of Internet version **mySAP.COM**					
mySAP Supply Chain Mgmt. mySAP Customer Relationship Mgmt. mySAP Financials		mySAP Product Lifecycle Mgmt. mySAP Business Intelligence mySAP Mobile Business		mySAP Human Resources mySAP Marketplace by SAPMarkets mySAP Hosted Solutions mySAP Technology	

Enterprise systems employ thin client/server (C/S) technology or client/ fat server (C/FS) architecture, creating a decentralized computing environment. In a C/S system a number of client devices operated by end users such as desktop PCs request services from application servers, which in turn get the requested service-related information from the database servers. The requests may be simple data files, data values, communication services, transaction processing or master file updates. The general practice is to have three-tier architecture such as in Figure 3. In this three-tier system the user interface runs on the client. To run ERP systems relatively powerful PCs (clients) and powerful servers are required where most of the hundreds of thousands of operations are performed. The client/server system functions are performed following three layers of logic:

- **Presentation Layer:** Graphical user interface (GUI) or browser for data entry or accessing system functions
- **Application Layer:** Business rules, functions, logic, and programs acting on data received/transferred from/to the database servers
- **Database Layer:** Management of the organization's operational or transactional data including metadata; mostly employs industry standard RDBMS with structured query language (SQL) provisions

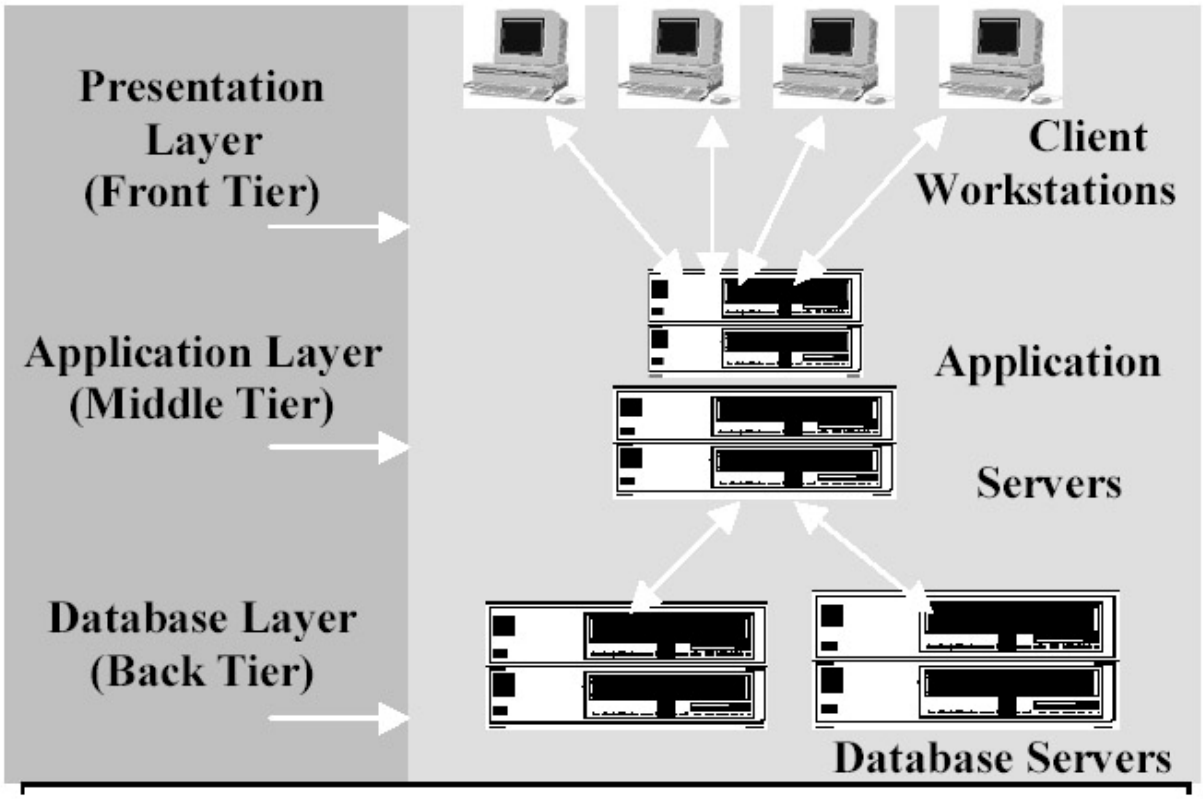

Figure 3: Three-tier ERP systems architecture

This logical arrangement helps the ERP user interface to run on the clients, the processing modules to run on the middle-tier application servers, and the database system to run on the database servers.

COMMERCIAL ERP SYSTEMS

The five dominating ERP software suppliers are SAP, Oracle, PeopleSoft, Baan and J.D. Edwards. Together they control more than 60% of the multi- billion dollar global market.

Each vendor, due to historic reasons, has a specialty in one particular module area such as Baan in manufacturing, PeopleSoft in human resources management, SAP in logistics and Oracle in financials. There are also about 50 established and a few more newly emerging smaller and midsize ERP vendors including third-party developers competing for the ERP market. The result is stiff competition and feature-overlapping products difficult to differentiate. Due to keen competition for control of the lucrative ERP market share, the vendors are continuously updating their products and adding new

technology-based features. Long-term vision, commitment to service and support, module features, specialty, experience and financial strength for R&D are considered the major vendor qualities for product selection and turnkey implementation. In the following sections we provide brief profiles of these five ERP giants.

SAP AG–Flagship Products *R/3, mySAP.COM*

SAP AG ("Systeme, Anwendungen, und Produkte in Datenverarbeitung"), or Systems, Applications and Products in Data Processing, was started by five former IBM engineers in Germany in 1972 for producing integrated business application software for the manufacturing enterprise (SAP, 2001). Its first ERP product, R/2, was launched in 1979 using a mainframe-based centralized database that was then redesigned as client/server software R/3 in 1992. System R/3 was a breakthrough and by 1999 SAP AG became the third largest software vendor in the world and the largest in the ERP sector with a market share of about 36% serving over 17,000 customers in over 100 countries. In 1999 SAP AG extended the ERP functions by adding CRM, SCM, sales-force automation and data warehousing. SAP has also invested significantly in its R&D sector with the result of newer versions of R/3 3.1, 4.0, 4.6 including Internet functionalities and other enhancements. SAP's Internet-enabled ERP solutions are provided by the recently launched ERP product called mySAP.COM. SAP has the broadest ERP functionality, capacity to spend significantly on R&D, strong industry-focused solutions and long-term vision.

Oracle Corporation–Flagship Product *Oracle Applications*

Oracle (Oracle, 2001), founded in 1977 in the USA, is best-known for its database software and related applications and is the second largest software company in the world after Microsoft. Oracle's enterprise software applications started to work with its database in 1987. It accounts for $2.5 billion out of the company's $9.3 billion in 1999, which places Oracle second to SAP in the enterprise systems category with over 5,000 customers in 140 countries. Oracles ERP system is known as Oracle Applications, having more than 50 different modules in six major categories: finance, accounts payable, human resources, manufacturing, supply chain, projects and front office. Oracle has other strong products in the software field including DBMS, data warehousing, work flow, systems administration, application development tools (APIs), and consulting services. A notable feature of Oracle is that it is both a competitor and a partner to some of the industry leaders in the ERP market such as SAP, Baan and PeopleSoft because of the use of Oracle's DBMS in their ERP systems.

Oracle has integrated its ERP solutions with the Internet and has introduced several applications in the electronic commerce and Internet-based commerce areas. Oracle's Internet infrastructure is created around two powerful products: Oracle9i Database and Oracle9i Application Server. Another significant feature of Oracle is its OSBS, or Oracle Small Business Suite which provides consistent financials, payroll, inventory control, order entry, purchase orders, and CRM functionality–all delivered as a Web service. Oracle also offers an easy-to-activate Web presence that helps companies to sell their goods via the Internet.

PeopleSoft Inc.–Flagship Product *PeopleSoft8*

PeopleSoft is one of the newest ERP software firms started in 1987 in Pleasanton, California, with specialization in human resource management and financial services modules. PeopleSoft quickly managed to offer other corporate functions and attained a

revenue of $32 million in 1992. Enterprise solutions from PeopleSoft include modules for manufacturing, materials management, distribution, finance, human resources and supply chain planning. SAP AG and Oracle–with longer experience, stronger financial base and worldwide presence–are the main competitors to PeopleSoft. Many customers comment that PeopleSoft has a culture of collaboration with customers, which makes it more flexible than its competitors. One of the strengths of PeopleSoft is the recognition by its customers that it is flexible and collaborative. The flagship application PeopleSoft8 with scores of applications was developed by PeopleSoft with an expenditure of $500 million and 2,000 developers over 2 years as a pure Internet-based collaborative enterprise system. "Our revolutionary eBusiness platform is the first open XML platform to offer scalability and ease of use for all users. PeopleSoft 8 requires no client software other than a standard Web browser, giving you the ability to securely run your business anytime, anywhere" (PeopleSoft, 2001). "Our eBusiness applications and consulting services enable true global operations–managing multiple currencies, languages, and business processes for more than 4,400 organizations in 109 countries" (PeopleSoft, 2001). PeopleSoft with about 10% market share, is the third largest ERP vendor after SAP AG and Oracle.

The Baan Company–Flagship Product *BaanERP*

Founded in 1978 in The Netherlands, Baan (Baan, 2001) started with expertise in software for the manufacturing industry and by 1997 claimed an ERP market share of roughly 5%. Bann's revenue in 1998 was roughly $750 million and while facing a slight slowdown in 1999 started growing again in 2001 with sales up 12% at £7,231million and operating profit of £926 million. Baan has more than 15,000 customer sites all over the world and more than 3,000 employees. Baan believes that "the Internet is the ultimate enabler" and "Internet technologies help companies become order-driven and customerfocused by enabling collaboration across the 'value chain.' Suppliers, distributors, manufacturers and customers can work together to deliver the right product at the right price." ERP solution areas that Baan covers include finance, procurement, manufacturing, distribution, integration and implementation, planning, sales, service and maintenance, business portals, collaborative commerce and business intelligence. Bann's flagship product is BaanERP (formerly called Triton, then Baan IV), launched in 1998. One innovative product from Baan is the Orgware tool that can cut implementation cost significantly by automatically configuring the enterprise software. Baan's ERP software is best known in the aerospace, automotive, defence, and electronics industries.

J.D. Edwards & Co.–Flagship Product *OneWorld*

J.D. Edwards was founded in 1977 in Denver (cofounded by **J**ack Thompson, **D**an Gregory and C. **Edward** McVaney) with long experience of supplying software for the AS/400 market. J.D. Edwards' flagship ERP product called OneWorld is "capable of running on multiple platforms and with multiple databases, ... [and] revolutionizes enterprise software by liberating users from inflexible, static technologies" (JD Edwards, 2001). The product includes modules for finance, manufacturing, distribution/logistics and human resources, quality management, maintenance management, data warehousing, customer support and after-sales service. J.D. Edwards' revenue jumped to $944 million in 1999 from $120 million in1992, having more than 5,000 customers in over 100 countries. The OneWorld system is considered to be more flexible than similar competing products and within the reach of smaller enterprises. J.D. Edwards' Internet-extended version of OneWorld was launched recently as OneWorld Xe ("Xe" stands for "extended enterprise").

EXTENDED ERP

The proliferation of the Internet has shown tremendous impact on every aspect of the IT sector including ERP systems becoming more and more "Internet-enabled" (Lawton, 2000). This environment of accessing systems resources from anywhere anytime has helped ERP vendors extend their legacy ERP systems to integrate with newer external business modules such as supply chain management, customer relationship management, sales force automation (SFA), advanced planning and scheduling (APS), business intelligence (BI), and e-business capabilities. In fact ERP is becoming the e-business backbone for organizations doing online business transactions over the Internet. Internet-based solutions are destined to improve customer satisfaction, increase marketing and sales opportunities, expand distribution channels, and provide more cost-effective billing and payment methods. The extension to SCM and CRM enables effective tri-party business relationships between the organization, suppliers and the customers. A supply chain management has sub-modules for procurement of materials, transformation of the materials into products and distribution of products to customers. "Successful supply chain management allows an enterprise to anticipate demand and deliver the right product to the right place at the right time at the lowest possible cost to satisfy its customers. Dramatic savings can be achieved in inventory reduction, transportation costs and reduced spoilage by matching supply with actual demand" (IBM, 2001). With the deployment of a CRM, organizations are able to gather knowledge about their customers, opening opportunities to assess customer needs, values and costs throughout the business life cycle for better understanding and investment decisions. The sub-modules found in typical CRM packages are marketing, sales, customer service and support systems using Internet and other access facilities with the intention of increasing customer loyalty through improved customer satisfaction.

E-commerce is the conduct of business transactions among organizations with the support of networked information and communication technologies, especially utilizing Internet applications such as the Web and e- mail, effectively reaching global customers. Adoption of e-commerce and e- business solutions, especially business-to-business (B2B) solutions, are seen by many as the wave of current and future extensions of traditional ERP systems of most small, medium and large vendors. The front-end Web-based Internet-business applications are integrated with the back-office ERP-based applications, enabling business transactions such as order placement, purchasing, inventory updates, employee benefits, etc. to take place between the customers, suppliers and the enterprise based on reliable, relevant data and applications instantly in a border-less domain.

The legacy ERP systems designed to integrate enterprise functions within the four walls of the enterprise have introduced software solutions with a Web-interface essentially extending to Internet-enabled CRM, SCM and other Internet-business models. Examples of such extended ERPs are available from most of the ERP vendors. Thus SAP's Internet-enabled integrated ERP system called mySAP.COM (SAP, 2001) is a suite of ERP, CRM and other products that can be linked together using Internet portals. The concept of the Internet-enabled extended ERP system is shown in Figure 4.

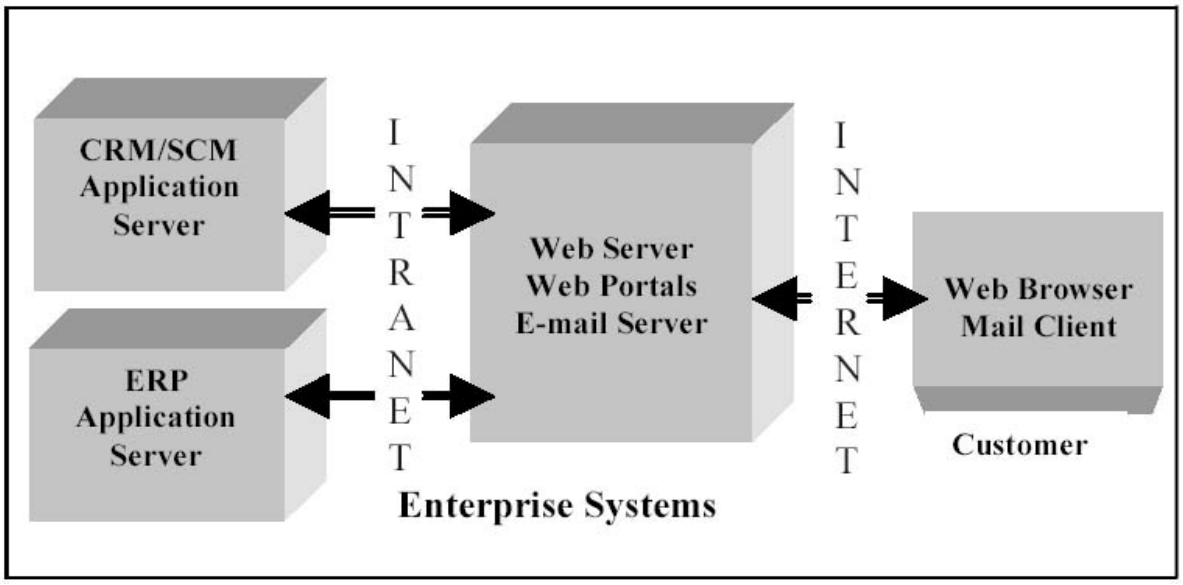

Figure 4: Web-enabled extended ERP system

An example of an extended ERP system may be Oracle's e-business suite of ERP systems that connects to CRM and SCM. Oracle's FastForward Web Store (Oracle, 2001) provides applications for establishing online stores for handling transactions and services with the possibility of linking into Oracle's ERP applications. ERP and e-commerce applications of an enterprise can share a common database with the deployment of Oracle Applications 11i (Oracle, 2001) integrating Web sites with ERP back-office applications. Baan has integrated its ERP, CRM and SCM with manufacturing management software. J.D. Edwards' Oneworld ERP package is reengineered to OneWorld Xe ("Xe" stands for "extended enterprise"), which enables the organization to extend the enterprise beyond physical walls to collaborate with customers, partners, and suppliers with additional tools for business-to-business (B2B) success. The Swedish ERP vendor Intentia International AB (Intentia, 2001) has a product suite called Movex that integrates ERP, CRM and other management software.

SUMMARY AND THE FUTURE

The major industrial information systems manufacturers that emerged from the 1980s and early 1990s defined the history of the development of ERP systems. Hence the major providers are representatives of certain industries as much as competitors in a common marketplace. To this extent there are still opportunities for new ERP vendors to emerge from industries that so far have not contributed to the ERP phenomenon. Some obvious examples are the aerospace industry, the finance industry and the logistics industry. Analysis of the market penetration of ERP systems shows clearly that the current players have to downsize their products and offerings to be attractive to SMEs. There appears to be no public discussion as to how this will be achieved and whether it requires a significant change in software architecture. This situation again is an opportunity for smaller players to seize the day and offer smaller systems running on smaller hardware platforms more efficiently. These innovators will ultimately take the lead in the ERP software market as large systems will not produce the continual income stream that small, robust, easy-to-use systems can achieve. Importantly these attributes contribute to a system becoming ubiquitous in the same way that Microsoft has achieved ubiquity for its operating system. Future successful vendors will capture

large markets of smaller businesses, who will provide a more consistent and enduring income stream.

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Chapter II: The Myth of Integration: A Case Study of an ERP Implementation

OVERVIEW

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This research examines the implementation process of an enterprise resource planning (ERP) system and shows that implementation cannot be viewed solely in instrumental terms–that is, organizations do not simply select systems based on information requirements so that proper "fit" can be achieved. Instead, this research suggests that the activities of selecting and implementing a new ERP become the medium for (re-)constructing or (re-)constituting the organization's values. Theorists have described such activities as a "mythmaking" process. A case study of an implementation at a large nonprofit organization is presented to demonstrate how myth-making served to construct an ERP system as an "integrated" system and at the same time served to elaborate existing organizational values. The myth functioned as a vehicle of consensual organizational reality, serving to align the acquisition of an ERP system with the organizational values, thereby garnering widespread support for a complex, expensive and relatively unknown technology.

INTRODUCTION

The purchase and strategic use of enterprise resource (ERP) systems by organizations has been offered as the solution to surviving in the emerging "e-based" economy by both practitioners and researchers alike. ERP systems have been heralded as the integrating mechanism for organizations, promising enhanced efficiency and effectiveness. Yet, as the media has recently reported, many companies have not realized the promise of this new technology. There is no dearth of trade and popular accounts depicting troubled and oftentimes failed ERP implementations (Deutsch, 1998; Knorr, 1999; Stedman, 2000). Information systems (IS) implementations in general are notoriously difficult; however, ERP implementations pose more difficult technological and organizational challenges than traditional implementations. For instance, a typical ERP contains 8,000 to 10,000 configuration tables and 800 to 1,000 business processes. ERP systems require much tailoring or customization in order to configure the system to fit the organizations' requirements (Scott & Kaindl, 2000). Yet, despite the mounting challenges of a successful ERP implementation, companies continue to purchase and install ERP systems to fit their organizations. By conservative estimates, sales for 2000 are projected between $15.5 billion (Computerworld Briefs, 1997) to $24 billion, with suggestions that this number could easily be inflated by a factor of five (Smith, 1999). Clearly, understanding how an ERP system is perceived as being a fit and thereby accepted by organizational members remains a critical challenge for both practitioners and researchers alike.

Given the relative newness of ERP systems, there is a dearth of literature comprehensively examining how these systems fit the organization in which they are implemented. However, we have recently begun to see the emergence of studies examining the implementation of ERP systems. For instance, Scott and Kaindl (2000)

examine variables that lead to an improved functionality enhancement process. They found that "swift trust" from the occupational community, conflict resolution, reciprocity, and informal networks impact functionality enhancement of an ERP system. In another study, Holland and Light (1999) use critical success factors such as software configuration and project management to examine their influence on formulating implementation strategies. And finally, Hirt and Swanson (1999) conduct an exploratory case study to examine the factors which may influence actual decisions and outcomes during an ERP implementation. Factors of importance include the relationship between restructuring and software adoption and implementation, the choice of software package, the pros and cons of alternative implementation approaches, the selection of hardware and the use of consultants. While these factor studies examining ERP implementations have yielded interesting results, implementation problems and failures continue to be a growing concern. "There now seems to be an emerging consensus that companies have failed to reap the significant benefits that this massive investment in ERP warranted. We must therefore ask some serious questions" (Smith, 1999, p. 34). The research here asks some of these questions by examining how "fit" between the ERP system and the organization is achieved such that successful implementation can be achieved.

The research presented in this chapter investigates the implementation of an ERP system as a social process of mythmaking. Myths are defined here as dramatic narratives of events used to explain the origins, transformations and ultimate ends of something. They serve to "explain" the way in which activities, whose origins are symbolic or perhaps nonrational, are linked to seemingly objective and rational goals (Tolbert, 1988). This chapter argues that mythmaking practices contribute to "aligning" the ERP software with espoused organizational values and objectives, thereby achieving a fit with the organization. The chapter adopts an interpretive case-study as a means of studying how implementing a new ERP at the same time served as a vehicle for elaborating the organization's values, thereby contributing to its acceptance by organizational members.

The chapter begins with a review of literature concerned with technology and organizational fit. Several observations are noted that underpin many studies in the area of implementation literature. The subsequent section develops the idea of myth and mythmaking as a heuristic for examining ERP implementations as a social process. This is followed by a discussion of the research framing of the project and a case description. The findings in the following section trace out how the myth of integration was created and sustained by members of the organization. Through the creation of this myth, the organization is able to obtain widespread support for the ERP and fit with the organizational context. The chapter concludes with a discussion and future implications.

INFORMATION SYSTEMS FIT AND RATIONAL CHOICE

The idea of organizational fit of information systems is a common research concern (Iivari, 1992) which has its roots in contingency theory. The concept of fit in this research points to the idea that the object of interest–the information system–must match its context in order to be effective. A concern with fit points us to information systems implementation literature which focuses on identifying factors–organizational and technological–which contribute to effective use or satisfaction with the IS. A review of this growing and varied area of literature is beyond the scope of this chapter (c.f. Cooper & Zmud, 1990; Iivari, Hirschheim, & Klein, 2000; Kwon & Zmud, 1987). In general, some of the more consistent factors that have been found to influence

technology acceptance include top management support, users' attitudes and resistance toward change, and relative advantage of IS as perceived by user. Relative advantage is the degree to which a technology is perceived as having greater benefits than other alternatives. In other words, the technology ranks higher in positive characteristics than do other practices, tools or techniques.

Generally speaking, the existing implementation literature has helped us develop a better understanding of IS implementation but has fallen short in providing a rich picture of the implementation landscape. "Most studies focus on small pieces of the MIS implementation puzzle, without considering larger issues," namely, the less tangible social issues (Kwon & Zmud, 1987, p. 231). These research tools produce a representation of an information system that is tidy, clear-cut and logical and exclude other areas of organizational activity. When considered, social issues are seen as distraction or complication in what would otherwise have been straightforward technical problems. Put another way, social issues often become relegated to the status of explanatory fixes, as secondary "patches" only after technical explanations have somehow failed. People do not figure in as social agents actively involved in constructing their work environments (Myers, 1995).

We can ill afford to ignore the less tidy organizational issues. The neglect of organizational issues has long been seen as a contributor to system failures and successes. Beginning with Lucas' (1975) identification of "organizational behavior problems" and running throughout research of the past decade (Ahn & Skudlark, 1997; Doherty & King, 1998; Ewusi-Mensah & Przasnyski, 1991; Hornby et al., 1992), researchers have found that "nontechnical" issues are major contributors to systems failures. Another related stream of research has recognized the importance of an organization's social context during information systems development (Hirschheim & Newman, 1991; Robey & Markus, 1984; Robey & Newman, 1996; Sabherwal & Robey, 1995). And finally, researchers working within a more hermeneutic tradition have argued that the introduction and use of information systems is a highly political process (Bloomfield & Coombs, 1992; Brown, 1998; Coombs, Knights, & Willmott, 1992; Knights & Murray, 1994; Myers, 1995; Walsham & Han, 1993).

This chapter contributes to a growing movement of process research on information technology, which draws from a multitude of social, philosophical, and political theories to examine how contextual elements influence and interact with information technologies in its cultural and institutional environment. To some degree, this approach is not inconsistent with the findings of the more rational factors based approaches. In fact, examining an implementation as a social process suggests a more complete picture of the IS implementation process by examining the process by which congruence with technological and organizational factors is achieved. In the case of a relatively new ERP system a social process approach allows us to deeply examine the process by which an unknown technology achieves a relative advantage over an existing information system, how users' attitudes are shaped and formed toward that technology and how top management mobilizes support for this system. In specific, this chapter examines the influence of the wider institutional and cultural environment (Barley, 1986; Orlikowski, 1992) during an ERP implementation. This chapter shifts the conventional rational focus of organization-technology research to a deeper social context by examining the role of myths as a heuristic for understanding the process of technological based change.

MYTHS AND STORIES

One theoretical tradition underpinning myths in organizational research is derived from the work of Meyer and Rowan (1977), who suggest that in order to understand and explain organizational structures and practices, we must understand *rationalized myths*. The myths are rational in that they "explain" the way in which activities, whose origins may be symbolic or social, are linked to appropriate technical objectives (Tolbert, 1988, p. 103). Similarly, Trice and Beyer (1984) define a myth as "a dramatic narrative of imagined events, usually used to explain origins or transformations of something … an unquestioned belief about the practical benefits of certain techniques and behaviors that is not supported by demonstrated facts" (p. 655). The position taken here renders no judgment as to the validity of myths. Instead the focus is on how myths and symbols directly shape human understanding and action in an organization. Both perspectives would suggest that myths are important because their creation and reproduction make the subjective seem objective and the nonrational appear rational.

Myths tend to be communicated via the medium of stories or narratives. These stories are both a form of representing experience as well as a tool of persuasion. Commenting on their persuasive nature, Mumby (1987) describes narratives as a "politically motivated production of a certain way of perceiving the world which privileges certain interests over others" (p. 114). They are used to create believable explanations for the teller's actions. In general, myths, stories or narratives, are modes of representation that are selected and invoked by tellers for different reasons and vary in their power to persuade; "they make us care about a situation to varying degrees as they pull us into the teller's point of view" (Reissman, 1993, p. 18).

Theorists also argue that stories serve to make sense of equivocal situations. When confronted by unclear situations, people will always tell a story to clarify and explain. Narratives allow participants to bring order to what would otherwise be very "messy" situations (Bruner, 1990). Boje (1991) has further argued that stories are recounted socially to formulate recognizable, defensible, and seemingly rationale collective accounts that serve as precedent for future action and decisions.
Theorists concerned with organizations have begun to use the idea of myths and stories to explain organizational phenomenon (Boje, Fedor, & Rowland, 1982; Boland & Tenkasi, 1995; Filby & Willmott, 1988; Gabriel, 1991; Martin & Meyerson, 1988; Weick, 1995). As an example of this rich and varied work, Quaid (1993) argues that a job evaluation system is a myth in that it is based on widely held beliefs that cannot be objectively tested. Further, "job evaluation is rationalized because it takes the form of rules, specifying the procedure necessary to accomplish the end goal of determining an internally equitable and externally competitive pay structure … job evaluation is expressed in a belief (ideology), an activity (norms and rituals), language and other symbolic forms through which the members of an organization both create and sustain views and images about the value of one job over another" (p. 239).

This chapter argues that during an ERP implementation, myths will be created which link the acquisition of a new and very unknown technology directly to rational objectives of the organization. The process of myth- making itself involves creating the appearance of an information system as an efficient tool, yet this belief cannot be objectively tested. In other words, there is no evidence that in fact the new ERP will assist the organization in accomplishing its end result of efficiency. Strategies used in mythmaking include language, rituals, and symbols, all of which contribute to producing a conception of information systems as a rational objective. For instance, individuals will

engage in certain "performances" at meetings that may seem unnecessary or inefficient. However, such performances provide the discursive space in which public support for the technology is demonstrated and solicited. It is in this discursive space that actors are afforded the opportunity to socially construct the new system as a technical necessity. Such practices render the decision more "legitimate" and in general contribute to constructing a believable myth about the ERP system. ERP implementation as myth is depicted in Figure 1.

Figure 1: ERP system implementation as myth

As the figure illustrates, myths are the links between symbolic purposes and technical objectives. For example, the information system may serve the symbolic function of legitimating or enhancing the reputation of the organization as a modern, cutting edge enterprise. Or still, it might simply fulfill consumerist desires of individuals to purchase the latest and best for the sake of acquiring it. Yet, the purchase, as an activity, must be rationalized such that it is linked to accomplishing the rational end goals such as more efficiently processing information.

In the area of information systems, research on myths and narratives has recently begun to emerge. For example, Brown (1998) examines the use of stories or narratives that organizational members produced to create meaning and gain political advantage during an IS implementation. In another, Brown and Jones (1998) examine a failed IS project and types of individual stories that emerge. Davidson (1997) uses narrative analysis to examine sense- making and interpretation during an IS development project. Dube and Robey (1999) examine stories as a symbol of organizational culture to generate insights into the collective interpretation of management practices by competing groups during a software development project. And finally Hirschheim and Newman (1991) contest information systems development as a rational process by using the concept of myth to interpret social actions during information systems development. The research here builds on this work by specifically examining an ERP implementation as mythmaking.

RESEARCH METHOD

This research was conducted within the interpretive perspective. Recent research on information systems implementation has indicated an interpretivist approach is most appropriate for the study of this organizational phenomenon (Myers, 1995). From an interpretivist approach, the world is seen as being made up of words, labels and concepts which humans use to construct social reality. Therefore, interpretive research requires that the researcher be immersed in a stream of organizational events (Evered & Louis, 1981) in an inductive attempt to create categories, or in this case myths, that are revised through the integration of data from observed experiences and the language use of organizational participants (Putnam, 1983). This immersion generates

"thick description" (Geertz, 1973) of an empirical account which was firmly grounded in theory (Glaser & Strauss, 1967; Turner, 1981).

The data collection for this case study began in January 1996 and lasted through December 1998. During the data collection period the researcher was involved in the implementation as assistant to the CIO. Her role was overt in that everyone knew she was conducting research on the implementation and would produce a case study for the organization. On several occasions she was asked for advice and suggestions at meetings she observed and provided feedback to the CIO on the implementation project. During the summer of 1998 the researcher provided a case-study write-up of the ERP selection to the CIO and project sponsor. The CIO accepted the case study. The researcher continued her observations until the end of 1998.

The data for this study were collected by the researcher primarily through unstructured interviews with 18 managers, a few semi-structured interviews, participant observations at 32 implementation meetings lasting between 1-3 hours each, dozens of informal conversations, and a survey administered to 213 participants. Most of the meetings were taped. The sampling method employed for the interviews is described by Marshall and Rossman (1995) as elite interviewing, "a specialized case of interviewing that focuses on a particular type of interviewee" (p. 94). These "individuals are considered to be the influential, the prominent, and the well-informed people in an organization" (p. 83). The survey administered included demographic information and open-ended questions asking participants from all levels of the organization to describe the new information system and the existing legacy system which was being replaced.

After transcribing tapes from the interviews, qualitative analysis proceeded iteratively. The researcher was involved in every iteration, allowing her to become "intimately familiar" (Eisenhardt, 1989) with the data. The analysis proceeded from open coding to axial coding (Strauss & Corbin, 1990). Selective coding, which usually follows axial coding, did not take place because after axial coding theoretical saturation was obtained. According to Alvesson and Skoldberg (2000), when using grounded theory the methodology can be modified; it is more a question of continually comparing newly coded data in a category with data previously coded in the same category until theoretical saturation occurs.

Open coding is the process of breaking down, examining, comparing, conceptualizing, and categorizing data. Once all the data were examined, the concepts were organized by recurring theme. These themes were candidates for a set of categories, which later linked a number of associated concepts. This is known as axial coding, which required that the researcher make connections between categories to construct a comprehensive story. At this point, an overarching *myth of integration* emerged that connected the categories. Further analysis of the data no longer contributed to discovering anything new about the category, at which point theoretical saturation was obtained. Precautions were taken to corroborate the interpretation (Miles & Huberman, 1994) through the data obtained in the survey and conversations with participants. The survey also provided a window into the language use of participants as well as verification of other concepts that emerged in the open coding of data. And finally, document analyses provided insight into the formal representation of the organization. That is, the formal documents provided added information on the organization's formal vision and values.

CASE DESCRIPTION

The organization chosen for the study is a large public research university located in the northeastern United States. Its annual budget exceeds $.5 billion, has enrollments of 24, 000, faculty of 1,184 and staff of approximately 3,600. The university is part of a five-campus system. Each campus has a chancellor as chief administrative officer, but all report directly to the university system president. The phases of the implementation covered by this study include initiation, information requirements analysis, request for proposal, proposal evaluation, and the selection of a new ERP system. At the time of the data collection the new ERP was not in production or in full test mode. Therefore, there is little information on the actual ERP system since it was not yet available for the researcher nor the participants to examine.

The implementation project, which will be called the CIS (campus information system) project, was directly under the control of the vice chancellor (and CIO) of the university. In the fall of 1995, before the CIS project began, university administrators publicly identified and targeted approximately $5 million to fund the purchase of a new information system and required hardware which would be owned and maintained by the campus. Four years later this amount had grown to $22 million. The ERP system was to handle student administration, human resources and financials. The new system was to replace the existing legacy systems which had been in place for over 15 years.

These legacy systems consisted of a combination of custom-built and vendor applications which had been extensively modified for specific university functions. The student registration system was built in-house using a System 2000 hierarchical database with some VSAM files. Information Associates, a vendor of higher education software, provided applications that handled student financial aid, bursar and financial functions. All three applications had been discontinued and were now updated and maintained in- house. Information Systems Incorporated provided the human resource application, which was also a discontinued application now updated by in- house staff. The operating system consisted of MVS ESA v4.3, CICS v 2.1.2, and OS/VS Cobol 2.4. All applications were located on an IBM 3090. A voice response system provided by EPOS was in use for student access to information and registration. Reporting tools included Data Analyzer and SAS. A central information services unit that reported to the president's office maintained all applications. This central information services unit, known as SAIS (State Administrative Information Services), also provided support to all other campuses in the university system.

The CIS project was lengthy and complex, involving individuals from offices throughout various levels and departments in the organization. Figure 2 illustrates how groups, composed of individuals from various offices, were structured to articulate their information requirements, issue an RFP and select a new ERP.

Figure 2: Structure of CIS project

The CIS project was broken into four major phases, consisting of information gathering, software evaluation, selection, and installation. The information gathering stage consisted of a 6-month-long requirements analysis process. During this process, project team members mapped out detailed information processing demands, or business rules, for managing student, faculty and staff information. Once completed, the business requirements document was used in the software evaluation stage. A call to software

vendors was issued asking them to submit proposals to fulfill the requirements as articulated in the business requirements document. Potential vendors were expected to respond with bids detailing how their software would meet the information requirements of the university and also detail what hardware would be required to house the new application. These proposals provided university staff with needed information to assess if viable software existed. The viable candidates were then invited to the university to give demonstrations. After the visits, and further follow-up, university staff identified one vendor which was then awarded the contract to provide an ERP system for the university.

THE MYTH OF INTEGRATION

During the implementation of the ERP system the campus engaged in creating a myth of an integrated system. For the most part, integration is used in organizational theory to define the level of collaboration between specialized units or individuals. Firms develop functional specialists that tend to have patterns of behavior and thought that are in tune with the specifics of their job and training. The different specialists may have conflicting thoughts and patterns about getting the job done. Integration, then, involves achieving the coordination and collaboration of these specialists through mechanisms such as communication and conflict resolution (Lawrence & Lorsch, 1969; Walker & Lorsch, 1996). As the data will show, this definition was not unlike that used by the various organizational members of the university.

Integration, it was believed, would be one of the most desirable benefits obtained from purchasing and installing the new ERP. The myth-making process served to render the new, untried, unseen, and expensive system as a tool by which integration would be achieved. But in creating this myth, the implementation activities of evaluating and selecting a new ERP served at the same time to elaborate and reconstruct existing organizational values. Specifically, the myth of integration was created through delegitimating the existing information system and its support structure. This was accomplished through creating a story of a "performance crisis" of the existing system. And finally, the myth of integration is further sustained by constructing a narrative of the ERP as integrated, thereby closely coupling it to the organizational value of integration. In the following section, data obtained from reports of technical and executive committees who met throughout the late '80s and early '90s, from interviews, and from a survey administered to all users involved in the CIS project are examined to show how the myth of integration was created and sustained.

The Performance Crisis

Consensus around the meaning and worth of organizational practices is essential for maintaining ongoing conformity to institutionalized practices (Meyer & Rowan, 1977; Scott, 1987). A performance crisis tends to erode institutionalized practices and create internal political dissensus (Oliver, 1992). This is in part due to the fact that performance crises tend to increase the potential for fragmenting socially shared templates for appropriate organizational activities and to increase internal conflict. In general, performance crises tend to contribute to the deterioration of consensus among organizational members. At the university the performance crisis was occasioned by a perceived haphazard expansion of the campus legacy system voiced by the new technical personnel.

The organizational arrangement between SAIS and the university was one that had been established in the early '80s and was not seriously contested until the early '90s.

SAIS, which reported to the President's Office and not the university, owned and operated the hardware and performed all software maintenance and development of the campus information systems. The departments of the university that required computing support paid into a common pool and SAIS would provide technical services to those offices. These offices queued up their requests for new development and then SAIS management would prioritize and assign them to programming staff. By the early '90s the university requirements for support had grown considerably. For example, in 1996 the student system, one of four systems, required 8.5 FTEs for programming, operations, data administration and other support services.

However, this structural arrangement began to rupture in the mid-1990s. When I interviewed three of the managers of the student area they characterized the expansion of the student system as being "ad hoc," "unplanned," and "uncoordinated." Most of the discussions with managers indicated that the information system expansion was driven by process changes in the disparate offices but there did not seem to be a coordinated overall strategy. In other words, it was a process-driven approach that involved piecemeal development of new applications and technology to different administrative processes. As one manager stated, "We're getting tired of Band-Aid solutions…no one knows what the priorities or direction are" (Interview, SSRRC, November, 1995). Other users I spoke with reported encountering considerable duplication of data and found information to be fragmented across a number of administrative systems.

In general, by the early '90s the information systems expansion had evolved into four separate but interacting systems that had been developed or purchased for admissions, financial management, human resources and student enrollment and registration. This complex suite of interacting systems was not synchronized in that some had been enhanced over time while others had been frozen (i.e., no longer updated) years prior. In addition to the expansion of the legacy system, the university also experienced a drastic growth in microcomputer-based technology and applications.

In the early '90s, there was a proliferation of local area networks and personal computing throughout this and other universities (Malaney & Alvarez, 1996). With this proliferation came the presence of a new cadre of technological personnel. As microcomputer use and networks spread throughout the campus, departments began to hire technical support staff. A host of new positions were created and filled that did not belong to the central SAIS organization. The new technical personnel organized committees to address their dissatisfaction with the mainframe legacy system, on which all the major departments relied. These committees issued scathing reports that directly criticized the legacy system and made strong pleas for a new information system and support organization that would be owned and controlled by the campus. In the spring of 1996, immediately before the CIS project was publicly announced, a committee issued an IT strategic plan. The committee was composed of 30 IS specialists representing a broad cross-section of the campus. However, no member of the SAIS staff was asked to participate. The strategic plan stated:

Administrative systems … are characterized today by out-of-date, unintegrated, labor intensive applications. Systems have been created in a haphazard manner and are either inaccessible or difficult to use. As a result, many offices have developed shadow systems that run independently of central systems (ITSP,1996, p. 5).

This report pointed to the dissatisfaction with the current information system product and its management. Lack of access and integration were identified as problems with

the existing information system. These reports and interviews suggested that the configuration of the existing administrative information system was a consequence of haphazard system development that had occurred over the years without systematic planning. That is, the information system environment consisted of redundant administrative applications that required extensive technical support.

Another report characterized the campus' dissatisfaction with the structural arrangement for providing technical support for the existing system as follows:

While this administrative structure may have certain advantages in allowing for the sharing of certain computer systems, it also leads to both cumbersome and lengthy procedures before any decision or action may be taken, since any given actions may have different impact on different campuses. This applies to both maintenance and development work, but the problem is most severe when dealing with new systems purchase or development. (CACCC, 1991, p.6).

Clearly, there was a growing sense of dissatisfaction with the information system product and services provided by SAIS. Greenwood and Hinings (1996) have argued that a high measure of dissatisfaction becomes a pressure for change. From this point of view, the dissatisfaction with the existing information system product and management can be interpreted as functioning as a pressure to delegitimate the SAIS arrangement. That is, groups began to recognize that the existing system and support structure was not to their advantage. As one manager told me, the critical disadvantage was that with SAIS as the service provider, "the campus did not have the ability to set priorities for system development" (Interview, December 15, 1996, EPZ). Discussion of abandonment of the existing practices was not yet apparent but some were strongly suggesting a revision or replacement of the institutionalized practice.

Rather than the "lump sum" assessment … each administrative area would individually contract … for computer services. Each area would then be free to specify its own needs and policies (within the limitations of the current applications and equipment) and also explore other ways of meeting its computing needs, including self- management or participation in a campus-based administrative computing organization which might eventually emerge. (ATF, 1992, p.7)

From the above, we can see that various actors at the university were attempting to revise the institutionalized practice to resolve their dissatisfaction with it. In other words, these groups had recognized that their dissatisfaction was linked directly to the existing organizational arrangement, or *template* as Greenwood and Hinings (1996) suggest. As they state, "dissatisfied groups must recognize the connection between the prevailing template (which shapes the distribution of privilege and disadvantage) and their position of disadvantage" (p. 1035) before change can occur. In this instance, the members of the Administrative Task Force, which consisted of 15 middle managers, had recognized that their interests were not being accommodated by the SAIS institutional arrangement and were pushing for revising the practice.

Although dissatisfaction with the information system and its management was growing, it was not enough for change to take place. As Greenwood and Hinings (1996) have argued, dissatisfaction with an existing practice is not sufficient for change to take place, constituents must recognize the possibility of an alternate template. That recognition of the alternate template was being formed through the reports similar to the one above and others of committees that were examining the current state of information system

management on the campus. For instance, the Administrative Task Force described the possibility of creating a campus-based data manager and argued that "such a position, properly developed, would result in an important step toward the goal of achieving a fully integrated campus computing environment" (ATF, 1992, p.5). These reports pointed to the beginning of an alternate information system.

In general, the performance crisis that members of these campus committees were describing at the beginning of the 1990s raised serious doubts about the legitimacy of the existing information system service and support. The seemingly haphazard expansion of the mainframe administrative system and the proliferation of network and technical personnel functioned to delegitimate the existing information system and its support structure. Committees reported on their dissatisfaction with the existing organizational information system arrangements on the one hand, and on the other they called for an information system that would allow for integrated processing. This theme of integration directly challenged the efficacy of the existing information product since the current product was constructed as fragmented and centralized.

The Integrated Campus, The Integrated System

Mythmaking activities throughout the implementation process centered on the theme of integration. These activities directly influenced the overwhelming support for the new software. More importantly, the implementation process, while serving to garner support, also served to align the new ERP with the organizational values of integration. Therefore, activities that involved constructing the new ERP as an integrated tool also served to reconstitute and reaffirm the organizational value of integration. In this sense, mythmaking activities helped to ensure that congruence between the ERP system and its environment was obtained. In this section the paper examines how this "fit" evolved by looking at activities that created and reinforced the story of an integrated and therefore "better" system. Specifically, data obtained in interviews, meetings and a survey are examined. It is important to note that this data was collected before the ERP was installed in either full scale test or production. Therefore, there is no concrete system that would allow the researcher to verify if in fact the perception of integration was consistent with some presumably "objective" standard of integration. Additionally, since the concern is with examining myths, whether or not integration is "real" or not is of little relevance to the study. What is at issue is what the participants socially constructed as real. This reality is verified through the use of their language and their responses to the survey.

The theme of integration was a very dominant one that was constantly reinforced by the project team, the consultants hired by the university, the CIO and chancellor. For example, early on in the project life cycle, in preparation for the kickoff meeting for the CIS project, one member of the project team described the objectives of the new system as, among other things, "integration ... flexible tunable system … allow for department control." As the project team carefully crafted a script for the kickoff meeting, they sat for several hours ensuring that everyone agreed on the message that was to be conveyed to attendees. The overall approach seemed to be to continue to discredit the existing system and support and construct an image of an integrated campus in need of an integrated system. For instance, at the first kickoff meeting the director of information systems began by attacking the existing IS legacy system and the support structure. "We outsource computing services [to the IS central office] but have no control over how they do it. Money is simply taken off the top for services." The CIO then described the ideal system, "In the past people had to work in silos … we were forced to think vertically. Now we are asking people to think and work

horizontally… in interactive and interdependent ways." The image of an integrated campus was constructed through her words and the new system would allow them to work in that integrated environment. She promised resources to transition into this new way of working. The story of an ideal system was sustained through the continued reinforcement of integration. The existing system was contrasted with the new in that the old was cast as "disintegrating," whereas the new was integrated.

More importantly, by creating the story of the ERP system as integrated, the supporters were able to establish a close match with the organizational environment. For the university the theme of integration was a formal organizational value that was strongly promoted by the upper-level executives of the organization. Integration was not a theme that had been created by the project team for the CIS project; it was a theme that the chancellor used in many of his public appearances and formal documents prior to the initiation of the CIS project. For instance, the campus' strategic plan, which was about 2 years in the making and involved approximately 10 committees whose members represented offices from throughout the campus, was replete with references to an integrated campus. In this plan, published about 1.5 years before the CIS project, the campus' goals are a follows:

Strive to achieve the greatest human potential among its students, faculty, staff and alumni, and through them and its integrative programs … The University will continue its historic commitment to removing barriers … The University will be integrative in all that it strives to do.

The document suggests integration for a variety of academic programs and projects on the campus. Integration, as expressed by the chancellor in his plan, evoked images of unification, cohesion, and collaboration. The objective of integration did not end in the strategic plan. Throughout public performances, such as faculty senate or board of trustees meetings, the chancellor continually reinforced the value of integration. His executive committee, composed of all the top executives of the campus, also supported this theme in their presentations and written documents.

What we can see here is that in fact integration was perhaps as much a symbol of the ideal state for the campus community as it was a description of the ideal system. Creating the myth of an integrated system and integrated campus worked to produce a close alignment between the technology and the organization, thereby establishing a good fit between the two. This close coupling was overtly stated in the request for bids issued for the purchase of the ERP. According to this document, the selected system "must be integrated with its environment as well; it can not be an isolated system, but one which much exist in the broader administrative, academic, and cultural setting of both the campus and the university system." The supporters of the ERP system were careful to align the ERP system to the organizational goals of the university. This is stated in the requirements analysis document issued during the implementation.

As you move along the continuum from least integrated to most integrated, the amount and complexity of system support activities performed by the institution's technical support organization are lessened and the value of vendor software maintenance services is increased. More integrated systems are normally less expensive to implement and maintain. *Considering the university's vision and these technical support implications, the Project Team and Directors' Group has determined the desired level of integration is most integrated*. [emphasis added]

The mythmaking activities surrounding the ERP implementation allowed members to elaborate the organizational value of integration. The rhetoric of organizational change was one of transforming the organization from fragmented to integrated, whereas the CIS project was to transform the information environment from a fragmented to an integrated one. However, the implementation of the ERP would allow both the technology and organization to be in congruence with each other, in a tight fit. The myth functioned as a vehicle of consensual organizational thought, serving to align the implementation team's various activities with the organization's values, but at the same time to reconstitute them.

In order for myth to be believed, to have the power of persuasion, it must be shared and sustained by individuals. This maintenance is evidenced in many forms, such as rituals, practices and language use. In this view, language is key in the creation and maintenance of a myth. This study examined the level of support and language use of participants involved in the CIS project. A survey was administered to 213 participants at all levels of the organization. At the time the survey was administered, the ERP was not yet in use by any members of the organization except a small group involved in testing. The response rate was 42.4% (n=86).

The survey contained a number of demographic questions (age, gender, years of work, etc.) and other questions that are not relevant for this chapter. The questions relevant to this study are discussed below as well as their results.

Overall, do you agree with the decision to purchase a new Student Information System (SIS) for the university?

Strongly Agree Strongly Disagree

1 2 3 4 5 6 7 n/a

In responding to the question of level of support for the decision to purchase and install an ERP (7-point Likert scale), findings show that there was overwhelming support–97.7% either somewhat agreed, agreed or strongly agreed. An open-ended question asked respondents to describe the benefits of the new ERP system.

What do you see as the main differences between the old student system and the new system? (Please be as detailed as possible.)

After reading and coding all answers to the description of the new system, the following categories and frequencies listed in Table 1 were obtained.

Table 1: Survey responses to open-ended question

The new CIS is/allows for:	Percent answering
Integration/interconnection	46.5%
Distributed/shared access to information	24.4%
Web based/new technology	18.6%
Flexibility	9.3%

Table 1: Survey responses to open-ended question

The new CIS is/allows for:	Percent answering
User friendly	8.1%
Efficient/better service to students	7.0%
Real-time access and/or updates	5.8%
Better reporting	3.5%
User configurable and updateable	3.5%
Campus-owned and operated	2.3%

The responses are revealing of just how successful the project team, consultants, and CIO had been in creating the myth of an ideal system that would be integrated and also accessible. In open-ended questions respondents used language that indicated that 46.5% believed the new system was either an integrated system or would allow for integration or interconnection. Yet, only 13.4% of those responding had actually used the new system. That is, only a select group of individuals were now in the testing phase and actually had any information by which to in any way judge whether the new ERP system was either integrated or not. However, the performances by CIS supporters rendered the ERP as an objective tool with integration ability, thereby distancing it from the social practices that produced it as such.

Another question asked about level of exposure to public presentations about the CIS project.

Please answer the following questions about your level of exposure to the new system.

1. I have obtained most of my information about the new system by talking with coworkers

Yes No

2. I attended a demo for the new software during the evaluation period (Summer97)

Yes No

3. I attended a demo for the new software after the decision to purchase was made (Fall97)

Yes No

4. I attended off-campus training sessions for the new software

Yes No

5. I attended a conference room pilot where I saw the new system and worked with the consultants

Yes No

6. I am currently using the new software in my office to do some part of my work

Yes No

None of the respondents were using the ERP system to perform their work so this question was discarded. The additional questions were summed for each responded. Fifty-four and seven tenths percent of the respondents stated that they had received most of their information about the ERP system from coworkers and nowhere else. These respondents had not attended public performances by project team members or the CIO, yet their language use seemed to reflect a belief in the new system as an integrated tool. This suggests that the myth was now being reproduced and sustained by others beyond the initial creators and supporters of the myth of integration. The myth of an integrated system seemed to have taken hold as it was sustained and recreated by organizational members at all levels of the organization.

CONCLUSION

This chapter has argued that much of the organizational literature on technology takes a very rationalistic and static approach to examining the changes that must take place for technology to become "aligned" with the organization. The research presented here provided a framework that punctuated the importance of social context as a key influence in an ERP implementation process. Specifically, this chapter has shown that information technology "fit" must be understood as dependent on a variety of complex social processes and cultural conventions, all of which render it an acceptable entity. Through the study of an implementation, this paper highlighted the crucial importance of mythmaking as the vehicle by which an existing system is delegitimated, a new ERP system is constructed as "integrated" and the story-making process served to align the technology with ideal organization values.

Thus far, mythmaking and storytelling could be suited for examining most software build or buy implementations. However, myths and their analysis are particularly relevant to ERP projects because, unlike other system development projects, ERP implementations place very unique demands on clients. ERP systems are described by supporters as integrated systems. These systems have been touted in the popular press as the panacea for integrating the "disintegrating" organization. Some have even termed ERP software "business integration in a box" or "megapackages" (Glass, 1998). This integration process spans the entire organization across departments. Whereas classic systems projects typically focused on a single unit and therefore a homogenous population, ERP implementation brings together a heterogeneous group of individuals, with different vocabularies and competing priorities. These clients are expected to define a common set of business rules, data standards, processes and procedures for the organization. Moreover, organizational practices must be fitted to the "best practices" imbedded in the ERP or abandoned in order to agree upon a new organizational view.

Therefore, more than in classic system build or buy projects, mythmaking practices function to resolve conflict that arises, reduce confusion, and persuade listeners about the practical benefits and value of an ERP. As we saw in the chapter, the benefit of integration was not supported by any concrete testable facts. Yet, they all described it as an integrated system that would bring a number of benefits to the campus. The mythmaking activities during the ERP implementation served to produce an information system as an objective tool whose acquisition would support the organizational value of

integration. In a sense, mythmaking activities link the acquisition of new, untried and expensive tools with seemingly "objective" organizational values. They bring order in the midst of a fairly unknown environment. Thus, mythmaking activities function as "alignment" mechanisms that allow the technology to fit to the organizational context.

And finally, if in fact myths do function to garner support and establish congruence with the organization, then analysts need to become better skilled at capturing and reinforcing myths which would mobilize support for the ERP implementation. Rather than dismiss myths as gossip or unreal, analysts would be sensitized to the function of myths and be able to actively capture them. In this sense, we might begin to shift our thinking of the analyst, no longer as engineer or scientist, but rather "analyst as anthropologist" (Alvarez & Urla, in press) who faithfully records and pays attention to myths conveyed by organizational members.

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Chapter III: ERP Systems in Universities: Rationale Advanced for Their Adoption

OVERVIEW

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This chapter outlines the significance of enterprise resource planning (ERP) systems and analyses the rationale used for their adoption. This study is structured around a theory of the motivations for investment in information technology (IT) to support core business operations. The data used for the study are documents published electronically on the Internet by universities. A content analysis was applied to this data. The chapter employs frequent use of quotes from the sources selected to assist the reader to understand the context and to verify the analysis. The findings are that the main reasons for adopting ERP are the modernization of systems, greater usability and flexibility, integration of data and systems, business process reengineering, an increase in the degree of electronic data interchange including the provision of Web-based interfaces to application systems, reduced maintenance and risk avoidance.

INTRODUCTION

Enterprise Resource Planning (ERP) systems have achieved considerable importance in the contemporary information systems arena. ERP systems are large and complex integrated software packages that support standard business activities. The scope of ERP systems, aligned with their numerous configuration alternatives and breadth of organizational impact, make the task of implementing them considerable, extending in many cases over several years. The extent to which ERP systems are shaping the IT industry is captured in the following comparison: "Twelve years ago, IT people identified their organizations as IBM or Digital shops, says Bruce Richardson, VP of Research at AMR Research Inc. They're now more likely to be SAP or PeopleSoft" (Sweat, 1998). The financial impact is correspondingly significant: "By early 2000 the ERP revolution generated over $20 billion in revenues annually for suppliers and an additional $20 billion for consulting firms" (Willcocks & Sykes, 2000). ERP systems have now been adopted by the majority of the Fortune top 500 firms and as the high end of the market becomes saturated, ERP systems are filtering down to medium- sized organizations such as universities and to regions beyond those initially penetrated in Europe and North America (Kumar & Van Hillegersberg, 2000). The phenomenon of the widespread adoption of ERP systems, described as the "ERP revolution" (Ross, 1999), leads us to question the reasons for its occurrence and the focus of this chapter is the rationale universities have used when adopting these systems.

THEORETICAL FRAMEWORK

The general question of how organizations shift from one technology to another is addressed by both economic theory and the theory of innovation. Economic theory postulates that in free economies the price system is the invisible hand that determines how resources are deployed and organizations behave. By adopting a new technology

that lowers the costs of production, a producer organization may be able to secure a price advantage and thereby achieve a greater market share or reap larger than usual profits until competitors copy the innovation. Even if economic reasons do not account for the adoption of new technology in a manifestly financial, quantitative sense, economic theory gives the further underlying explanation that human beings and therefore organizations also, since they are controlled by people, are utility maximizers and act rationally (Simon, 1978). Consequently we may assume that by adopting an innovation organizations believe they will derive benefit from so doing.

Economic theory therefore gives insight into the reasons why innovations are adopted. The theory of innovations explains the process of how they become accepted. Rogers (1983) conceptualizes the stages which occur during the process of innovation as: "(1) knowledge (be exposed to), (2) persuasion (form a favorable attitude to), (3) decision (decide to adopt), (4) implementation, and (5) confirmation." The first three stages are of relevance to this study. With respect to Stage 1 we may note that in the modern world there is a vast reservoir of knowledge, creating a potential information overload, so there must be underlying reasons why organizations are receptive to some types of information more than others. Why does the organizational information filter enable exposure to ERP knowledge, so that the innovation process may commence? It appears discomfort levels felt with existing technologies condition this receptivity to new knowledge. Once discomfort levels with existing information systems become sufficiently strong, an organization may be prompted to contemplate alternative systems and therefore be receptive to the type of innovation known as an ERP system.

Ward (1996) suggests that investment in IT systems to support core business activities is made for the following reasons:

- Improving the performance of existing activities (speed, accuracy, economics)
- Integration of data and systems to avoid duplication, inconsistency and misinformation
- Avoiding business disadvantage or allowing a business risk to become critical

In our present context we may anticipate that if an organization is experiencing dissatisfaction with the performance of existing systems, difficulties due to a fragmented data and systems environment, business disadvantage from not having an ERP system or severe operational problems due to the inadequacy of existing systems, it will be sensitized to an awareness of alternative systems. Using these general propositions relating to investment in IT for core business activities as a general framework, we may assess the attitudes of ERP adopters towards existing systems to determine if they are congruent with these categories.

METHODOLOGY

This study examines the rationale employed by universities as ERP adopters. Universities are a specific vertical market targeted by ERP vendors, which enables market effects that might be uneven across industry sectors to be eliminated, as suggested in an earlier study of software make or buy decisions (Rands, 1992). A variety of documents relating to their ERP projects have been published by universities on electronic media to inform their stakeholders and to develop consensual attitudes and behaviors towards the implementation stage of their ERP project. Educational institutions, especially universities, value reasoned argument and rationality–it is their raison d'être; consequently, their stakeholders will expect the decision to adopt an ERP

system to be based on reason (Pfeffer, 1981). From the population of universities that have adopted ERP systems, a sample of four universities were selected: two high-profile universities who presented moderate to large quantities of data, the University of Michigan and the University of Colorado, and two institutions whose material was more limited, the University of New Orleans and Central Queensland University, Australia. Whilst this study is limited in that universities represent one specific segment of the ERP market, it is likely that many of the attitudes towards ERP adoption manifested by universities resonate with those of other types of enterprises.

Justifications published on the Internet constitute a primary and exclusive source of data for this study. Intranets and the Internet are commonly used today to inform stakeholders of new policy directions and activities. Consequently it was felt that if a university desired to publicize its ERP acquisition it would tend to use this medium. An interpretive approach was chosen to analyze this data. The framework provided by Ward (1996) was used as a starting point for performing a content analysis (Krippendorf, 1980) of the data. Published data is ideally suited to content analysis, which has the advantage of being an unobtrusive research technique (Webb, Campbell, Schwartz, & Sechrest, 1966). Essentially the approach taken is similar to that of the historian who reviews documents and creates a theory from them to explain social and economic events that occurred in the past. Krippendorf quotes Dibble (1963) in comparing the activity of a content analyst to a historian: "When historians make an effort to infer events from documents they are, by definition, involved in content analysis." Whilst such an approach is uncommon in studies of information systems, a case for historical studies in the discipline has been made (Mason, McKenney, & Copeland, 1997). The integrity of a content analysis rests on the same standards of reproducibility found in the sciences, namely, that given the same observations, methodological approach and framework, another scientist would draw the same conclusions. In the following analysis the data is presented in its most interesting and expressive form, namely, the language used in the original documents. This approach has the added advantage of countering the ambiguity inherent in textual data, since the reader is exposed to the original language and can verify the meaning for him/herself (Langley, 1989).

ERP JUSTIFICATION

Improving the Performance of Existing Activities

With age, IT systems develop symptoms which diminish their effectiveness as a vehicle for providing organizational support. Ageing technology is frustrating to users and difficult to adapt to changing requirements. Even though they do not "wear out" like physical systems, software systems become relatively more unserviceable with age. Legacy systems in most organizations have developed a reputation as an inhibitor to change because of the inflexibility inherent in third generation software technology. These systems are both difficult and costly to adapt, characteristics that are well-known and have received wide recognition. "Eventually an organization will reach the stage where it becomes almost impossible to enhance the existing systems further because they are too slow and uneconomic" (Kelly, Gibson, Holland, & Light, 1999). Many universities did not feel they could fully address the information-system-related problems they were experiencing through in-house systems redevelopment. The market for software systems has matured since universities installed most legacy systems, reflecting the current preference for commercial off-the-shelf systems. "Since designing and implementing integrated software packages is not the business of most companies, or a focus of their executives, the systems their internal personnel come up with will

never equal the quality, scope, or technology of those created by software firms whose business this is" (Lozinsky, 1998).

Building a cost-effective software application that rivals the functionality available in the marketplace would be nearly impossible. (University of Colorado, 2000)

All sources examined expressed dissatisfaction with their legacy systems, for example:

The majority of central administrative systems are 10-25 years old. In most cases, the systems are providing the foundation for institutional data. While many of these systems have had major modifications to adapt to changing requirements, the original design and intent of the systems remain a barrier for users. (University of Michigan, 1995)

Systems, including the payroll system, are 20+ years old and are seriously outdated. (University of New Orleans, 1999)

Developments in the sophistication of personal computers (PCs) since the mainframe era have added new dimensions to the human-computer interface. This new technology has had the effect of making legacy system terminal interfaces appear dated. Technological influences were discernible in a number of instances, for example, current systems were compared unfavorably to more modern systems because they are:

mainframe-based, none of the systems take advantage of "pointand-click," "drop-and-drag," state-of-the-art technology. (University of New Orleans, 1999)

This suggests that an awareness of new operating styles may increase interest in replacement systems which have more modern interfaces. In addition, new technologies open up the prospect of new ways of operating and interacting with customers and suppliers, for example:

The University needs to increase the use of electronic documents internally and the exchange of information electronically with external organizations through the use of industry standards such as Electronic Data Interchange and Electronic Funds Transfer. These steps will simplify business processing, reduce costs, and leverage technology to provide quality services by the most effective means possible. (University of Michigan, 1995)

Users became conscious of the fact that the capabilities of legacy systems were functionally inferior to more modern PC-based systems. Data held on mainframe computers was not always accessible as desired and neither did users have the means to manipulate it to the required format. Originally most of these systems were never envisaged as flexible query and reporting tools. Flexibility is an expectation that has arisen since these systems were first developed and its absence has developed into a perceived inadequacy expressed in the following:

Our data environment is characterized by redundant data entry, ***cumbersome tools for data access***, questionable data integrity, and ***unnecessary restrictions on access to information*** [emphasis added].

(University of Colorado, 2000)

User ad-hoc reporting capability is limited. (University of New Orleans, 1999)

In universities worldwide, an era of tight funding has focused attention onto more streamlined administrative systems, to reduce costs with the intention of releasing resources for core activities. New technologies open possibilities of fresh approaches to business processes that appear to offer greater efficiencies when compared to existing business practices.

To deal with the projected decline in state funding support and to reduce the pressure to increase tuition, costs need to be contained or reduced. Of particular importance is the need to focus on personnel costs, which are the largest component of the expenditure base, and the need to streamline processes and procedures which add to administrative costs. (University of Michigan, 1995) Administrative Streamlining Project (A.S.P.) flowcharted (or "mapped") the HR and Financial processes of over 360 University units. When analyzing those flowcharts, it was determined that **over 50% of the steps that are completed for a transaction** could either be handled efficiently through automation, simplified, or eliminated. … This approach attacks the inefficiencies in administration and provides an opportunity to save administrative costs **without reducing service.** (University of Colorado, 2000)

In summary those conditions which encourage an organization to consider alternative systems, which arise from a desire to improve performance are: a declining level of satisfaction with legacy systems, outdated interfaces, inflexible mechanisms for data retrieval and reporting and a desire to modernize business processes using technologies that facilitate electronic data transfer between the customers and suppliers of the organization. Attributes of ERP systems that are perceived to reflect these deficiencies and aspirations provide further supporting rationale for their acquisition. We may regard flexibility, usability, accessibility, Web-based interfaces and potential for business process reengineering as features of ERP systems which, given the previously expressed needs, would tend to form a favourable attitude towards them.

- **Flexibility.** ERP systems possess superior data retrieval capabilities partly because they are integrated and also because they are based on a common relational data model. This provides more flexibility to users, which explains why they are viewed favorably. Strong query and reporting abilities. Unlike our current systems, the ability to access and query the data elements is greatly expanded. (University of Colorado, 2000)

Easier, quicker access to data for reporting and decision-making. (University of New Orleans, 1999)

- **Usability.** ERP systems are primarily based on the client/server architecture which provides a modern desktop user interface. The modern user interface implemented in ERP systems is likely to meet usability expectations and will help to form favourable attitudes towards ERP systems in the minds of potential adopters.

Utilizes a client/server architecture. (Central Queensland University, 1998)

- **Business Process Reengineering.** ERP systems incorporate an increased capacity for electronic processing of data in comparison with that available in legacy systems. This opens up the prospect of the organization applying reengineered business processes that may be faster and more cost effective. Some prospective purchasers of ERP systems have identified processes that they wish to reengineer and will tend to form a favourable attitude towards ERP systems because they deliver this

functionality. Alternatively, others recognize that the adoption of an ERP system will provide an opportunity to introduce new procedures that will eradicate existing inefficiencies. Attitudes favourable to the adoption of ERP systems will be enhanced to the extent that ERP systems are perceived as agents of changed processes.

Users will be able to take advantage of electronic forms entry and authorization through the use of worklists in the initial product. New releases of the product will provide broader workflow capabilities. (University of Colorado, 2000)

Implementing the software includes "streamlining" (or reengineering) the way we do business. (University of New Orleans, 1999)

- **Internet Accessibility.** In common with many other businesses (e.g., banking institutions) universities are seeking opportunities to enable customers (students) to perform query and update functions via the Internet (e.g., changing and confirming enrolment in courses). This provides a more flexible form of service to students and also reduces the requirement to provide staff to perform these services. Ability to make use of current technologies, for example, Web-enabled applications. (University of New Orleans, 1999)
- **Simplified Maintenance.** One of the main issues affecting university administrators was the difficulty of maintaining existing systems so that they could keep pace with changing requirements. There is an apparent expectation that ERP products will maintain currency in the future and therefore remove the organization from exposure to risks incurred from outdated systems. This perception of ERP systems enables them to be viewed favorably.

The University is able to acquire vendor-provided maintenance which will ensure the University's administrative information systems will be well tested, proven, and continually updated. (University of Colorado, 2000)

Quicker development time for system enhancements. (University of New Orleans, 1999)

Simplified maintenance is also a dimension of the desire for integration of data and systems discussed in the following section. Fewer systems tend to lower maintenance activity and cost.

Integration of Data and Systems

The historical development of information systems, firstly from discrete mainframe-based application systems to distributed solutions, has in many organizations resulted in a plethora of systems. This has resulted in inefficiencies on two main dimensions. Multiple discrete mainframe applications with their different design strategies frequently have different operating commands, users' interfaces, databases and maintenance requirements. This creates a number of problems: additional training overheads because of the different operating styles, potential inconsistencies in data since each application has its own database, and complex maintenance strategies. Problems caused by multiple databases are evident from the following.

Our data environment is characterized by ***redundant data entry***, cumbersome tools for data access, ***questionable data integrity***, [emphasis added] and unnecessary restrictions on access to information. (University of Colorado, 2000)

The other dimension is the situation where different sections of the same organization have different applications with broadly similar functionality. Autonomous software acquisition by sections within the organization, driven by an attempt to overcome inadequacies in centralized legacy systems, results in shadow systems that have some degree of duplicate functionality.

Shadow systems have developed resulting in "increased information systems investment, duplicate data entry, inconsistent reporting results or output, and wasted time." In fact, during the A.S.P. Detailed Assessment, A.S.P. found that almost **every** department that was reviewed had a shadow system to track either human resource or finance data. (University of Colorado, 2000)

Organizations motivated to reduce this complexity in their information systems' infrastructure are likely to be receptive to the idea of integrated systems. The ability to integrate different applications into a single software product simplifies the management of IT and increases usability through a common look and feel. The sharing of data between applications reduces the need for keying and eliminates inconsistent data. As ERP systems provide an integrated database and suite of applications with a common look and feel they appear to provide a solution to these deficiencies.

Better, integrated desktop tools. (University of New Orleans, 1999)

An intuitive, easy, common look and feel across the entire product line. Users won't have to learn how to use different systems to accomplish daily administrative tasks. (University of Colorado, 2000)

The products are structured to share data elements and allow users to link finance and human resource information. (University of Colorado, 2000)

Avoiding Business Disadvantage or Allowing a Business Risk To Become Critical

ERP systems are a comparatively recent technology, and no evidence to support the proposition that not having an ERP system constituted a business disadvantage was discerned. Establishing whether ERP systems are a business necessity is a research question for the future.

Legacy systems can become unsound and erratic due to continued modification over an extended period and their continued use may pose a business risk that could become critical if they cannot properly support core business activities or if they become unstable.

The current Student System is unable to support core University functions (such as the management of student information) and must be replaced as a priority. (Central Queensland University, 1999)

Modifications are difficult to implement and can produce unpredictable, unintended and undesirable consequences, which may impact adversely on organizational performance

to the extent that a business risk eventuates. One university expresses this issue as follows:

Modifications are costly and become a high risk endeavour. (University of Michigan, 1995)

Legacy systems, because of their longevity, were also exposed to year 2000 (Y2K) adaptation problems. Y2K was unique, universal and conspicuous. Failure to address Y2K would have been a severe and probably catastrophic shock to any organization so it was clearly a business risk. It is believed ERP adoption was stimulated by the Y2K issue. "Many companies have ... implemented ERP in response to Y2K concerns" (Markus & Tannis, 2000). In common with every other organization, universities needed to address the Y2K issue.

Existing administrative applications (Human Resources, Student Administration and Financial systems) are legacy systems running on an IBM mainframe platform. Some of the systems, particularly Student Financial Aid, will encounter significant year 2000 difficulties. (University of New Orleans, 1999)

For some organizations, Y2K had the effect of stimulating an interest in alternative IT systems. If alternative systems could be found that were Y2K- compliant, remediation of existing systems could be avoided. Y2K therefore acted as a stimulus to search activities for replacement systems. ERP systems with appropriate functionality were likely to come to the attention of organizations as candidates for consideration.

ADDITIONAL CONSIDERATIONS

Vendor Profile

As we have already noted the ERP phenomenon is driven by both software vendors and adopting organizations. ERP systems could not be a solution for adopting organizations were it not for the fact that software companies are selling ERP systems. "Many of the events in these studies suggest a mating theory of search. Not only are organizations looking for alternatives; alternatives are looking for organizations" (Cyert & March, 1963). Important as it is, the way in which ERP products came to be available is not the focus of this chapter. We confine ourselves to the view of the adopting organization, which appears to look beyond the software product itself to the profile of the supplier organization.

Ongoing maintenance of the product, the use of proven technology, relevant functioning reference sites and seven-day support are illustrative of the expectations purchasers have of vendors. (Central Queensland University, 1998)

The vendor's perceived strength and stability is very important to purchasers. This is connected to the issue of risk. Universities do not wish to invest in an ERP system intended to provide institutional support for many years unless they are convinced that the vendor is a stable supplier.

We would not have made this major commitment to PeopleSoft if we had not been convinced of the company's long-term viability. (University of Michigan, 1997)

Economics and Financial Risk

Installing an ERP in a university may cost US$65 million or more, which represents a substantial financial commitment. The scope of ERP adoption is subject to variation as it depends on the range of modules implemented by a particular university. ERP adoption generally requires expenditure on hardware including servers, workstations and network infrastructure, the ERP software package, consultants to assist with implementation and the cost of replacing staff seconded to the ERP project. Data obtained from the planning phase at the University of Colorado shown in Table 1, is indicative of relative costs. This data supports those studies that show costs associated with the implementation process are considerably more than the cost of hardware and software.

Table 1: A relative cost example

Cost Component	Cost
	$(000's)
Labor Cost, including implementation partner labor	20,757
Software Costs	4,316
Hardware and Network Costs	3,793
Training Costs	2,025
Operating Costs	1,753
Total	32,644

Financial benefits include quantifiable factors such as reduced staffing costs as well as nonquantifiable factors such as better information. As ERP systems are replacement systems, it should be to nomic rationale: "It is possible to argue that a 'technology' investment cannot strictly give a return on investment unless it replaces an older technology and carries out the same functions more efficiently" (Ward, 1996). To justify a $35 million investment in an ERP project, one university used payback and internal rate of return (IRR) calculations. The IRR of circa 9% was above the university's hurdle rate of 5% but does not suggest ERP adoption was an overwhelming financial imperative given the uncertainty inherent in such calculations. Also the timescale envisaged for the investment is reasonably long–"at least a decade"–but probably realistic in the light of the longevity of current legacy systems (University of Colorado, 2000). As an ERP project is extensive, the process of formal assessment is complicated, which may make one infeasible for some organizations. The importance of financial motives is unclear with respect to IT investments, especially large ones. It has been suggested that universities do not always mount a financial case for IT investments. "Where the system is fundamental to running the organization and delivering services, there may be no choice but to invest. …This may cause some universities to neglect the cost-benefit analysis of proposed IT projects. Some of these will be operational or competitive necessities, which will not give you any competitive advantage, but will keep you in the game and thus are necessary for survival" (Vitale & Johnston, 1997). This suggests it would not be unusual for a university to dispense with a formal analysis of their ERP investment. In all industry sectors the larger and more complex a project, the more difficult it is to assess all the likely impacts.

Consequently the decision to adopt an ERP system is primarily based on a qualitative assessment of the issues we have already discussed. There may or may not be a financial analysis, but even if there is, it does not appear to be the dominant criterion. It is acknowledged, however, that the method of data collection used in this study could have been inhibiting with respect to uncovering the financial issues, since some universities may have decided not to place financial data on the Internet.

Economics tests the resolve of the organization to adopt an ERP system. Funds for this investment must be allocated from the adopting organization's budget. "An organization's economic intent is largely expressed through the budget which exercises control over allowable behavior within the organization. Budgets are allocated to departments or divisions which exercise functions in which the organization wishes to engage" (Cyert & March, 1963). Unless the organization is motivated to allocate sufficient funds from the budget to acquire an ERP system, the investment cannot occur. This suggests the desire to adopt an ERP system, if it has developed, will be tempered by its affordability, as is common to economic transactions of all types.

A risk assessment is a vital component of any substantial investment decision. Aspects of risk assessment relating to the investment search were addressed earlier in this chapter. When the decision is made to invest in an ERP system, financial risks must be considered. Financial risks depend on the magnitude of the ERP investment relative to the organization's resources. The size of the investment required to implement an ERP system is substantial, which makes this is an important issue for a university to consider.

A significant up-front investment will need to be made and amortized over future periods. The overhaul of the University's business processes and technology will require a large commitment from the University community as current systems and processes have to be maintained until the solution is in place. (University of Colorado, 2000)

Timescale

ERP adoption is justified partly in terms of the need to address problems experienced with existing information systems and also by the desire to modernize and introduce newer and more effective technologies. The confluence of a business need to replace existing systems and the availability of a suitable alternative are required for innovation to occur. The need to replace is not always urgent, unless special factors like Y2K are in effect, nor are suitable alternatives necessarily available. In the persuasion phase the organization develops a favourable attitude to the innovation, which may result in a decision to invest in an ERP system. The gestation period in which problems are gradually recognized and progressively worsen may continue for some time. For example, at one university various committees completed assessments of information systems over a period of several years. In May 1991 it was reported, "systems are not meeting the needs of financial users"; in September 1992, that "significant improvements in … management information systems are needed." A further report in March 1994 endorsed the findings of the previous two and culminated in a RFP in April 1996 (University of Colorado, 2000). This long gestation period in the case of universities seems to suggest either a steady, deepening awareness of the problem until it reached the point at which action was stimulated or a type of marking time until an innovation appeared.

CONCLUSION

We have examined ERP adoption in universities using a framework provided by a theory of investment in IT. This theory explains why new information technology is adopted. The theory of investment in IT for core business processes was in general compatible with the rationale provided by universities for their ERP investment. Where the ERP experience differs from the theory is in matters of detail. Whereas for former generations of IT investment speed, accuracy and economics were the basis of the rationale for performance improvement, these do not appear to have been such important considerations in the case of ERP investment. Usability, flexibility, more effective maintenance, business process reengineering and the modernization of systems, particularly electronic interfaces to suppliers and customers such as those provided via the Internet, now dominate issues of performance improvement. Integration of systems and data is confirmed as a powerful motive for ERP investment. Risk avoidance is also a motive for renewing legacy applications with more modern ERP systems, which are assumed to present fewer maintenance problems. A model of ERP adoption embracing this revised theory is presented in Figure 1.

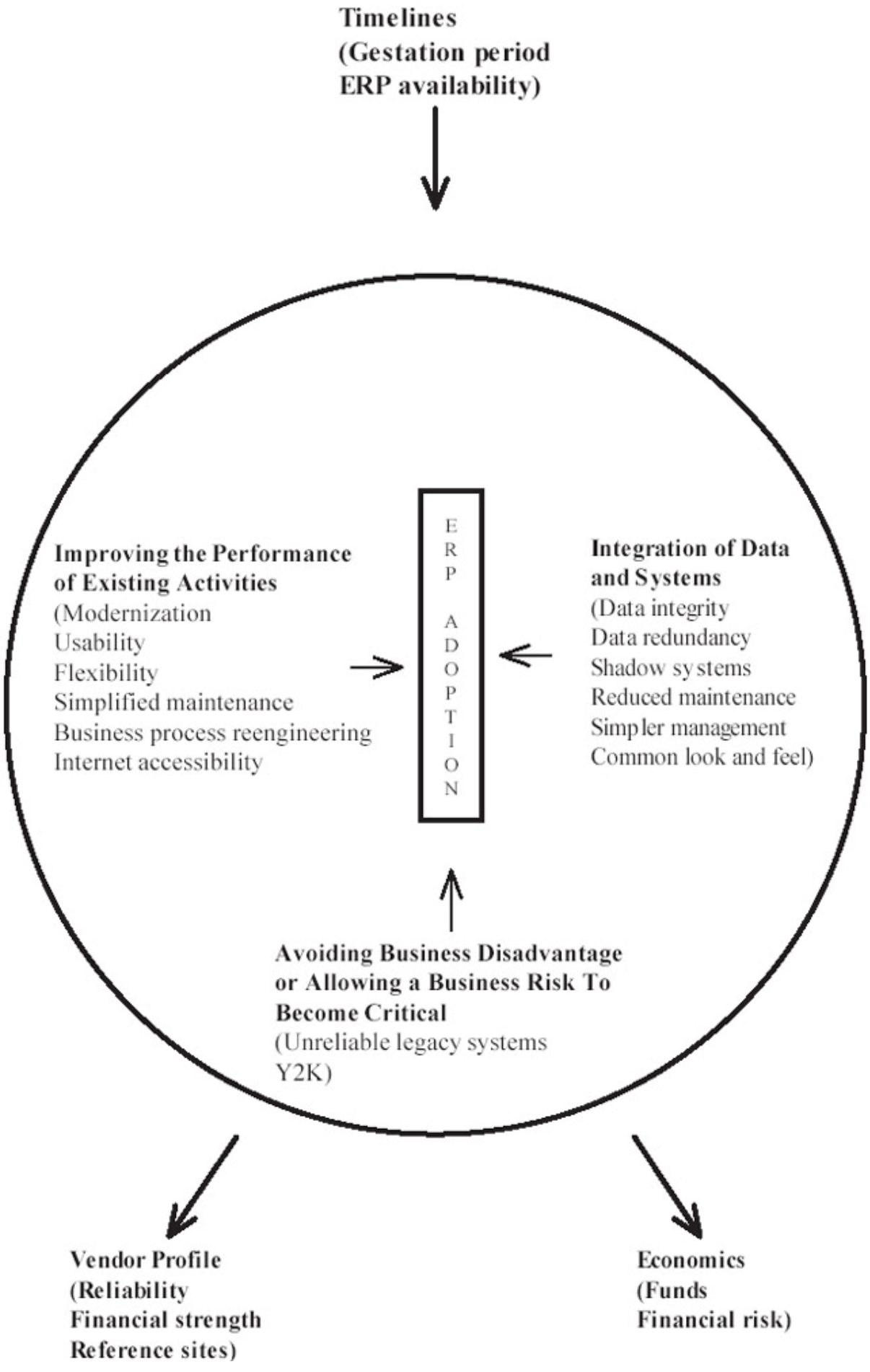
Timelines
(Gestation period
ERP availability)
Improving the Performance
of Existing Activities
(Modernization
Usability
Flexibility
Simplified maintenance
Business process reengineering
Internet accessibility
ERP ADOPTION
Integration of Data
and Systems
(Data integrity
Data redundancy
Shadow systems
Reduced maintenance
Simpler management
Common look and feel)
Avoiding Business Disadvantage
or Allowing a Business Risk To
Become Critical
(Unreliable legacy systems
Y2K)
Vendor Profile
(Reliability
Financial strength
Reference sites)
Economics
(Funds
Financial risk)

Figure 1: ERP adoption model embracing this revised theory

As ERP systems become established we may look to the future and consider the implication that they will become the legacy systems of tomorrow. The process of innovation may be presumed to continue to provide alternative solutions. Whether these alternative systems attract the interest and attention of managers in organizations will depend on how adaptable ERP systems prove to be. If ERP systems satisfy organizational expectations then the degree of attention paid to possible alternatives will be low. If dissatisfaction with ERP systems develops then, as has been observed in this study, alternative solutions to supporting core business activities may be contemplated and history may once again be seen as repeating itself.

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Chapter IV: Assessing Enterprise Resource Planning (ERP) Adoption in the Philippines

OVERVIEW

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INTRODUCTION

The Philippines has already embraced today's fast-paced global economy. The worldwide advent of e-commerce has driven the Philippine business community to deal with changes in the way business is conducted–extending its reach, working to provide better services for customers, working more closely with suppliers and partners, and tapping new markets.

Developments characterized by the new global economy require a shift in the management paradigm of enterprises which gives premium on competitiveness, multifunctionality, and flexibility. This requires managing the technological factors of the enterprise (managing technology and managing with technology) and managing the enterprise for controlled change and stability (Khalil, 2000).

ERP can be viewed as a valuable resource that can provide various capabilities to companies that use it. It can be a source of competitive advantage for a firm. However, the successful adoption of ERP, especially in developing countries like the Philippines, will require culture modification within a firm as it involves revolutionary changes in the way people will be doing things, especially in developing countries like the Philippines. This modification raises some issues which point to the viability of ERP's use in the Philippine context.

This chapter presents an overview of ERP adoption in the Philippines by examining four Philippine business enterprises as case studies. These firms are part of global enterprises with parent companies abroad. The chapter investigates the organizational context within which ERP is applied in the Philippine setting. It also looks at the problems and issues raised by said firms in their use of ERP as a tool to achieve efficiency in the organization.

The major question that this chapter addresses is: What organizational factors play a crucial role in the successful adoption of ERP in the Philippines? Specifically, what are the forces that either drive or restrain Philippine business enterprises from adopting ERP?

The chapter's objectives are: (1) to describe and analyze the factors and forces which either facilitate or restrain ERP adoption by Philippine business enterprises; (2) to present views and surface assumptions on the value of ERP as a tool to achieve

competitive advantage; and (3) to help provide insights on how organizational factors such as management's role and organizational culture contribute to successful ERP adoption.

CONCEPTUAL FRAMEWORK

ERP adoption by specific Philippine enterprises is assessed based on the resource-based view (RBV) of the firm and the culture perspective on organizations.

The resource-based view of the firm looks at resources and capabilities as the source of a company's competitive position. The value of these resources and capabilities, in turn, is determined by the dynamic interplay of three fundamental market forces: demand (do they meet customers' needs, and are they competitively superior?), scarcity (are they imitable or substitutable, and are they durable?) and appropriability (who owns the profits?). Under RBV, a company's valuable resource can be of three forms: physical (like state-of-the-art manufacturing equipment), intangible (brand names or technological know-how), and an organizational capability embedded in a company's routines, processes and culture (Davenport et al., 1999).

External market tests also affect the views of companies in determining whether a resource is valuable and can be the basis for an effective strategy. These factors include: (1) inimitability (whether the resource is hard to copy or a similar software is difficult to create); (2) durability (how quickly the resource depreciates); (3) appropriability (who captures the value that the resource creates); and (4) substitutability (if the resource can be trumped by a different resource).

One significant component in analyzing the system processes is organizational culture. Organizational culture is a set of important understandings that members of an organization share about what is and what is not so and about what should and should not be in the organization (Gonzales, 1987). It is also a set of commonly shared ways of thinking, believing and doing things in the company, whether in the formal or nonformal context (Jocano, 1988). The cultural dimension of the organizational system includes the elements of values and guiding beliefs stemming from their mission/vision. Values are the essence of a company's philosophy for achieving success, providing a sense of common direction for all employees and guidelines for their day-to-day behavior (Deal & Kennedy, 1980). Beliefs, for their part, are external (beliefs about how to compete and direct business) or internal (about how to manage and direct the organization). They are the roots and principles upon which the company is built, the philosophical foundation of the corporation and the precepts upon which strategies get formulated (Davis, 1984).

METHODOLOGY

The etic (outsider) approach was adopted in the study. This approach emphasizes the outsider's categorization of meaning and reading of reality, making use of presumably objective methods such as document analysis, surveys, and interviews, among others. While there were limitations in employing an emic (insider) approach in the study, a glimpse of the organizational cultures were obtained by taking note of the company values and beliefs through direct observation and through interactions with key informants. Assumptions that bear upon ERP use were gleaned and confirmed by the interviews.

Case studies of four companies–three from Cebu and one from Manila– are shown in this study. These companies represent different industries with diverse experiences of ERP. Interviews of key informants, particularly those managing the company's information systems, were conducted in the first quarter of 2001. Documentary analysis of organizational reports and training modules was also made.

It should be noted that data which were not made available to the researchers by some companies reflect the culture as well as obtaining conditions in the organizations. The gaps in information are retained as these speak of the changes which the companies were undergoing at the time of the research.

CASE STUDIES

Company 1: Fairchild Semiconductor, Inc. (Cebu)

Fairchild is a leading international semiconductor company noted for producing power, interface, analog, mixed signal, logic, and configurable product devices. Its headquarters are in South Portland, Maine, USA, with fabrication facilities in West Jordan, Punchon; a wafer die preparation facility in Singapore; and assembly and test plants in Cebu, Philippines, Kuala Lumpur and Penang, Malaysia, and Wuxi, China. The case presented here focuses on the plant in the Philippines which is based in Mactan Economic Processing Zone, Lapu-lapu City, Cebu.

As stated in its Cebu plant, Fairchild's vision/mission is to establish and maintain a healthy and safe environment while maintaining customer service through the involvement of all employees, thereby eliminating company risks and creating a sound workplace for its employees and a wholesome community.

Fairchild embarked on ERP as a corporate-wide initiative in 1997. It did not have a complete system when the company was still National Semiconductors prior to 1997. Instead, it adopted some modules (e.g., accounting) from National Semiconductor's headquarters in Santa Clara, California. When the company was bought by Fairchild, the new management decided to have an integrated software package to handle all aspects of the operations.

Choosing ERP

According to Fairchild's information systems manager, Mr. Esau Villagonzalo, it took about 3 months for them to deliberate on what ERP system would be right for the company. Key people from Fairchild's different manufacturing sites (including Cebu and Penang) went to the headquarters in South Portland, Maine, and stayed there for a month to come up with a detailed specification, such as number of characters, field length, and lot numbers, among others, for selecting a system. Vendors such as PeopleSoft, Oracle, and SAP were evaluated according to the following criteria: (a) demonstration of the actual system– 50%; (b) submitted proposals–20%; and (c) cost–30%.

In evaluating the vendors, teams representing manufacturing and planning conducted sessions to discuss their findings. While they noted that Oracle's financial modules were good, PeopleSoft's human resources system was favorable. In addition, PeopleSoft earned a few more points in the evaluation given other considerations such as customer base, number of manufacturing sites, and cost.

Fairchild started implementing ERP in August 1997, with the human resources component in the initial phase. This was done in 1 to 2 months' time. Inventory followed; however, the company encountered problems in the second phase of implementation. Although teams, consisting of a project manager, functional representatives, IS representatives, and those from different areas, were created, difficulties in learning the system cropped up. Users at Fairchild's shipping area did not fully understand the software and have bypassed the software when difficulties arose. Errors in the application were noted. Another problem was the slow response of the server which was in South Portland, Maine. Moreover, the existing database then was not properly tuned. This resulted in discrepancies on the inventory amounting to millions of dollars plus added cost in reconciling records.

While at the outset the budget for the acquisition of PeopleSoft's system seemed lower than that of its competitors, the implementation resulted in a budget which was about three times the initial amount because of expenses for training and customization. The budget for Fairchild's ERP project worldwide and the initial cost of software was about US $14 to 18 million. Actual cost including travel, training, and additional hardware amounted to US $40 to 50 million.

Among the concerns that the company had to look into are:

1. the need for pre-orientation, especially among the staff;

Only the management level was involved at the start of the project. Those in the lower levels were apprised of the system only 3 to 4 weeks before implementation. Providing the staff (as users) with a background at the initial stage could have prepared them better for the use of the package, decreasing resistance to learning the new software.

2. the implications of a decentralized environment (such issues as response time and database application are also deemed important); and

3. the interface between processing and loading/maintenance and manufacturing systems.

The first case illustrates the concerns of a typical manufacturer implementing ERP in the electronics industry. The main focus of such an enterprise in its implementation of ERP is in the area of inventory and materials management. Similarly, the company being taken up in the second case also prioritized materials management, but unlike the first one, the second company is in the telecommunications sector and with the added peculiarity of being a company in transition. At the time of this writing, it is merging with an established telecommunications company in the Philippines.

Company 2: Isla Communications Co Inc. (ISLACOM, Cebu)

ISLACOM was borne in 1990 and given a special mandate through Republic Act 7372 aimed to develop a full-time service telecommunications network in the Philippines. It pioneered the country's first digital mobile communication service in 1994 using GSM world standard digital technology. By the first quarter of the year 2000, Ayala Corporation, Singapore Telecom International and Deutsche Telekom integrated their resources into ISLACOM and Globe Telecom, paving the way for the creation of the

Globe-ISLACOM family. As it is, the company continues to provide landline facility and digital mobile telephone services with national and international reach.

ISLACOM's vision is to provide effective telecommunication service in its pursuit to contribute to national growth and global cooperation through social, economic and technological development. ISLACOM's objective is that by the year 2005 it will be the market leader in telecommunications in the Visayas and a close second/third in market share in the service it provides to the rest of the country.

The criteria used by ISLACOM in selecting the software were: (1) cost and (2) an integrated package for a total solution of the company's business needs. ISLACOM was able to get a substantial discount from SAP by using the privilege of Deutsche Telekom, being a subsidiary of said company. SAP also answered the company's need for an integrated system, having modules for finance, budget and controls, materials management, plant maintenance, and sales and human resources. Finance, composed of general ledger, accounts payable, controlling and project system, was first implemented using Siemens as the consultant. Later on, Fixed Asset Accounting was added. Materials management, for its part, was implemented using Andersen Consulting as the implementing consultant.

The company has adopted SAP's servicing module, particularly materials management (MM) in mid-1999. The project to adopt the SAP MM under- went several processes: (1) assessment and planning, which commenced in July 1999; (2) business design and prototype; (3) end-user training; and (4) roll-out planning and support leading to the actual use in September 1999.

There was no clear budget for the finance module. However, the budget for SAP's materials management module was placed at US $550,000 to include expenses for the consultant (Andersen Consulting, Manila), training, and customization (by Siemens). A project director and five full-time consultants worked on the project. The company's IT group and users were involved, starting from the conceptualization stage. This somehow ensured effectiveness in the implementation stage because people at the outset were involved in the planning and agreed on the process that will be undertaken.

A problem mentioned by the key informant was the cost overrun stemming mainly from added customization expenses. To control this, when specifications were obtained from the users to include the cost, requisitioners would sign an agreement form, making them stick to what was originally planned. Any changes in the original budget plan would be reported to the higher-ups (e.g., the controller) for justification.

The impending merger with Globe Telecommunications, however, is a concern which could bear upon the current software system which ISLACOM is using.

As seen in the first two cases, the companies involved felt that emphasis in its ERP implementation should be on materials management. However, in the third case, priority is given to financial management and maintenance management. The next case shows perspectives in ERP implementation in the power generation business, making it unique compared to other types of enterprises given its own needs and requirements.

Company 3: Cebu Private Power Corporation (Cebu)

The Cebu Private Power Corp. (CPPC) was borne in December 1996 as a joint venture company between East Asia Diesel Power Corporation (EADC) and Visayan Electric Company (VECO). Through the Power Purchase Agreement entered into by CPPC and

VECO in 1996, CPPC was to construct a 51.1 MW power plant to service the requirements of VECO (East-Asia Power Annual Report, 1997). CPPC is distinct compared to the aforementioned companies in that its operations are mainly to convert fuel to electricity, which is distributed by the Visayan Electric Company, its sole client. Its vision is "to showcase Filipino excellence in the power generating industry, creating a brighter world for everyone."

It has adopted Oracle's financial modules sometime in 1994-97, mainly because it was what its parent company, East-Asia, was using. When asked what ERP modules are considered important for the use of the company, its general manager, Mr. Roger Lim, mentioned those concerning management of people, operations, finances, and logistics planning. For CPPC, the least useful is marketing since it only has one company to service and marketing feasibility studies have already been made prior to the setting up of the power plant in Cebu. He added that the software which one needs would basically depend on the nature of one's business.

The first three cases depict the peculiarities of ERP implementation in the manufacturing, telecommunications, and power sectors. The fourth case, for its part, tackles ERP implementation of a manufacturing and distribution company.

Though it is similar to the first case in the sense that it is also in the area of manufacturing, it is also different in that the company concerned also handles product distribution to its end customers.

Company 4: Sterling Tobacco Corporation (Manila)

Sterling Tobacco Corporation is a manufacturer of low-priced Virginia type cigarettes. It is majority-owned by PT Handjaya Mandala Sampoerna Tbk., an Indonesian company with business interests in resorts and leisure, retail, and tobacco. The company manufactures and sells domestically the following major brands: Stork, Miller, and Bowling Gold. It has a 3.5% market share of the 77- billion sticks/year market. Its plant is located in a 4.8 hectare lot in Mandaluyong City in metropolitan Manila.

The company vision is to be No. 2 in the industry. Its mission statement:

Product: To produce and sell innovative, distinct and premium-quality tobacco products consistent with its consumer needs;

Consumers: To ensure availability, freshness, and satisfying taste of its products at affordable prices;

Customer/Trade Partners: To provide value-adding customer service, integrity in all business transactions, and fair return to its trade partners;

Employees: To provide a conducive workplace for its people-ensuring continuous professional development and careers which capture expression of their competencies and rewarding high-performing employees;

Work Values: To work in a results- and customer-oriented environment with a strong sense of urgency, total quality, excellent execution, professionalism, and teamwork;

Technology: To efficiently use technology and adopt best practices which strengthen its competitive position;

Community: To be a responsible corporate citizen, contributing to the upliftment and development of the community; and

Shareholders: To safeguard the investment of its shareholders through the intelligent use of company resources maximizing shareholders' value.

Mr. Manolito Dagatan, country manager and also general manager of the company, when interviewed expressed his belief that ERP is a very valuable resource of their company which could give them competitive advantage if properly implemented. Last year, the company installed Oracle Financials and has been implementing its application modules piecemeal. The modules now operational consist of general ledger, accounts payable, fixed assets, and budgeting. Accounts receivable is undergoing implementation but the company's biggest problem is how to capture sales data. The company sells their products nationwide through salesmen out of 16 sales depots. The problem they face is how to electronically transmit sales data from the field to the head office in Manila which will then be used as inputs to the accounts receivable module. As a solution, they are thinking of equipping each salesman with a handheld billing computer. The data captured by the handheld computer will then be transmitted to the head office in Manila through the Internet or telephone line.

The adoption of ERP in Sterling Tobacco Corporation was in response to a directive from its Indonesian parent company, PT Handjaya Mandala Sampoerna Tbk. Sampoerna had Oracle Financials running and decided to roll it out to its Philippine subsidiary. To assist in the installation and implementation of the software, Sterling engaged the services of James Martin Consultancy (now Headstrong) for a fee of US $100,000. However, the engagement had to be terminated in midstream due to the client's dissatisfaction with the progress of the implementation. Luckily for the company, at the time that Oracle Financials was being implemented, they hired the incumbent MIS manager, Mr. Rey Ricardo Rivor, who has had a wide experience with ERP, having himself implemented Oracle. Mr. Rivor therefore was able to monitor the implementation of the software and evaluate the consultants' performance.

At the time of this writing, Sterling is set to implement inventory and purchasing by October 2001 and MRP1 and MRP2 by the second half of 2002.

The interview with Mr. Rivor elicited the following comments with respect to the requirements for successfully implementing ERP in Sterling.

With regard to the technical aspects of implementing ERP (specifically Oracle Financials), Mr. Rivor does not see these as posing much of a problem. Save for their bad experience with the consultancy, the company has technically competent people that could very well handle ERP implementation, as they are doing so now. What he sees as a big problem and a source of great frustration for him is the lack of understanding by a big part of his organization of what ERP really can do for the company. He senses the difficulty of convincing people involved with the use of the software to shake off old habits. He sees the need for them to adopt a challenging attitude towards the way things are presently being done in the company. He also sees the need to develop a sense of urgency among the members of the organization to replace the complacency that seems to pervade within the company. In short, the company needs a change in its organizational culture. The reason is that ERP software is designed based on the best

business practices. When introduced into a company, the software assumes that the user is also employing the best business practices. Therefore, there needs to be a realignment of the company's way of doing things with those practices upon which the ERP software was built. People in the organization should be asking the question "Why not?" instead of "Why?" And this requires a modification of their common thought processes and beliefs.

Based on interviews with Mr. Manolito Dagatan, Sterling's country Head and general manager, and Mr. Rey Ricardo Rivor, MIS manager, the following comments were obtained as regards the value of ERP as a company resource and a basis for an effective strategy.

While various ERP software can be purchased from several vendors and therefore can be available to Sterling's competitors, the sheer cost of an ERP package ($200,000 for software and hardware, including server) plus the installation fee ($100,000) would prevent less financially gifted competitors from acquiring and using it. Effectively, this would make the resource inimitable as it could only be acquired at great expense and especially if considered in combination with all the other resources of Sterling.

On the question of how quickly the ERP software loses its value, Mr. Rivor says that its value will remain for a long time. This is because the price of the package includes all future enhancements and revisions on the software that the vendor would make. In effect, the software will remain current and up-to-date.

ERP AS A VALUABLE STRATEGIC RESOURCE

The benefit of implementing ERP is to get a strategic competitive advantage for the organization (Ushasri, 1999). ERP creates value for the firm as its proper implementation will ultimately lead to efficiency and cost savings for the company in the long run. In spite of the great cost of putting into place an ERP system, the future cost savings that it can generate for the company will far exceed its cost even on a discounted basis.

Competitors who are non-ERP users are definitely put at a disadvantage in terms of capabilities as they continue to carry out business activities using less efficient and less responsive business processes.
Table 1 summarizes the highlights of the four companies' ERP experience.

Table 1: ERP experience: Fairchild, ISLACOM, CPPC and Sterling Tobacco

	FAIRCHILD	ISLACOM	CPPC	STERLING TOBACCO
A. ERP Experience Start	1977	Finance – 1998 Materials Management – mid-1999	Financial Module (sometime 1994-1997)	2000
B. Software	Oracle – Financials PeopleSoft – HR, Shipping	Oracle– Financials SAP servicing modules – MM	Oracle– Financials	Oracle– Financials

Table 1: ERP experience: Fairchild, ISLACOM, CPPC and Sterling Tobacco

	FAIRCHILD	ISLACOM	CPPC	STERLING TOBACCO
C. Adoption Experience	First tried HR–1-2 months Inventory	2 months	*	Phase 1:Oracle Financials Phase 2: Inventory & Purchasing – Oct. 2000 Phase 3: MRP 1 & 2 – mid-2002
Estimated Budget	US $40-50 million (total cost–worldwide operations)	US$550,000 including consultant cost	*	US $400,000
Approach	Teams created (project manager, reps for functional, IS & different areas)	Staff & IT collaborate starting conceptualization stage; agree on process	*	MIS Manager in charge of monitoring and evaluation
Problem Encountered	(PeopleSoft) Shipping–users slow response (dbase not properly tuned)	Cost overrun	*	Lack of appreciation of ERP Sales data capture & transmission to head office
D. Considerations for Choosing Software	Criteria a) demoactual system–50% b) request for long list–20% c) cost–30%	Integrated package Cost	Company need based on nature of the business	Integrated software with parent company Cost
Other Concerns/ Issues & Needs	Pre-orientation Infrastructure Interface bet. Processing & Loading (Maintenance & Manufacturing System) Decentralized environment - response time an issue	Merger with GLOBE Billing system coding structure difficult	*	Organizational culture modification Electronic capture and transmission of sales data

Table 1: ERP experience: Fairchild, ISLACOM, CPPC and Sterling Tobacco

	FAIRCHILD	ISLACOM	CPPC	STERLING TOBACCO
* data unavailable				

COMPARATIVE ANALYSIS OF CASES

The selected companies' views on ERP based on external market tests are shown in Table 2.

Table 2: Views of Fairchild, ISLACOM, CPPC, and Sterling Tobacco on ERP

Views of ERP	FAIRCHILD	ISLACOM	CPPC	STERLING TOBACCO
Views of ERP 1. Inimitability (resource hard to copy/ replicate)			*	Inimitable as it could be acquired at great expense.
	Difficult to copy. Basic (e.g., financial requirements) and standard but customization crucial.	Many enterprising Filipinos can design system based on local requirement. Technology appropriate to environment.	Area/important module–concerning mgmt. of people, operations, financial management, logistics planning Least useful–marketing Use depends on nature of business	
2. Appropriability (who can capture the value that the resource creates)	Areas most useful–shipping, inventory, financial, manufacturing Least useful–asset management Most important user–managemen	Area–materials management –User		Whole firm, especially management and finance

	t			
3. Durability (how quickly the resource depreciates)	Does not depreciate quickly. - standard -	Standard	*	Software will remain for a long time.
4. Substitutability (can be trumped by a different resource)	Difficult to copy but locals can design system with same functions given proper guidance.	Cebuanos can do the program.	Yes.	*
* unavailable/not answered by respondent				

On Inimitability

The first and fourth companies consider the creation or duplication of a similar software quite difficult to do given resource constraints. The basic software requirements are standard but the crucial part is the customization. Nevertheless, the first company's key informant believes that with proper guidance, it is possible to design and develop a software to perform the same functions as those found in ERP.

The second and third companies, however, believe that Filipinos can design systems which are comparable to those offered by vendors from abroad–if not better, since these are more attuned to the requirements of local businesses. However, funding can be a major constraint in developing such a system.

On Appropriability

The differences in priority areas where ERP can impact on the organization stem from the type of operations and industry these companies are in. For the manufacturing industry (companies 1 and 4), components that affect shipping, inventory, and financials are important. For the service sector (company 2), materials management can be a priority. For the power sector (company 3), maintenance, human resources, operations, financial management, and logistics planning are more significant. Emphasis is given on maintenance of equipment, which is critical to their business. All cases, however, commonly view management to benefit most from the ERP system, especially when there is a need to have an overall picture of the operations.

On Durability

All companies see ERP as a resource which does not quickly depreciate. The components are standardized. Much of its use will depend on how it is customized to suit user needs.

On Substitutability

All companies investigated believe that ERP as a resource is difficult to copy with limited time and resources, but with proper guidance, Filipinos can design and develop a system to perform the same functions. Other ERP vendors can provide equally good software. What is essential is that one must be able to identify which component or area one vendor is strong at. The second company, for its part, views Filipinos as possessing the capability to design its own programs, which may be equally competitive as those by foreign vendors.

The findings here suggest that ERP is generally viewed as a valuable resource by raising organizational efficiency. This is achieved through standardizing procedures and data for end users on all levels. While the notion of stability may be gleaned from the responses on durability (that the system is not quick to depreciate), the responses on the other items do give rise to the issue of flexibility. The concern on customization leads companies to explore the possibility of developing locally designed systems that would tailor-fit local requirements and do away with problems of added expenses and time loss. Moreover, the fact that the companies do not fully adopt all the modules in the ERP software seems to challenge the holistic and integrative appeal of ERP as a system when it is applied to the Philippine setting.

ORGANIZATIONAL CULTURES

Among the things that have to be considered in the adoption of ERP by local companies is whether or not organizational cultures lead to conducive environments for new technological applications. Values that permeate the organizations can provide clues on the effective use of resources or tools such as ERP. The vision/ mission and organizational values of the companies studied relevant to ERP are shown in Table 3.

Table 3: Vision/mission and organizational values of selected companies

About the Organization	Fairchild	Islacom	CPPC	Sterling Tobacco
VISION/ MISSION	To establish and maintain a healthy and safe environment while maintaining customer service through the involvement of all employees, thereby eliminating	Has a social responsibility to provide effective telecommunication service in its pursuit to contribute to national growth and global cooperation through social, economic and technological development.	To showcase Filipino excellence in the power generation industry, creating a brighter world for everyone.	To be no. 2 in the industry.

Table 3: Vision/mission and organizational values of selected companies

About the Organization	Fairchild	Islacom	CPPC	Sterling Tobacco
	company risks and creating a sound workplace for its employees and a wholesome community.			
ORG. VALUES	Time is essential. Knowledge is important.	User participation ensures smooth implementation. IT has a supporting role.	Excellence, responsibility, empowerment, and safety are of utmost concern.	Time and "can-do" attitude are important.

The organizational values of the four companies are gleaned from their vision/mission statements, as well as from the answers given by respondents during the interviews.

All four companies emphasize excellence in the organization. All companies are results-oriented. In this regard, information and timeliness are key to achieving this. People are regarded as valuable resources. Positive attitudes and effective participation contribute to attaining excellence and safety in the performance of work. Said companies also experience challenges to these values from some organizational members who are resistant to change and are less time-conscious. These challenges stem from negative assumptions such as fear of new technology and learning something new as time-consuming. It is significant to overcome these assumptions since the effective use of a technological tool such as ERP is hinged on a mind-set that is open to change.

Apparently, the management level has internalized the values that are relevant for ERP to work. What is needed is to make these values pervasive throughout the organization so that other members who are likewise users of the software would be able to maximize the benefits to be derived from it.

CONCLUSION

In the Philippine context, a number of factors have to be considered for ERP to be successfully implemented.

While ERP promises the benefits of an integrated system, companies inter- viewed only had partial implementations of the package. This partial implementation of ERP does not really provide the true benefits one would expect from ERP.

One of the main constraints is the huge customization cost to be incurred in using "canned" applications from vendors. High costs include hiring of foreign consultants as well as training of users. Cost overruns are usually experienced. Selecting the appropriate components to be applied to the organization is a key concern. Customization has always been mentioned as a problem by the Philippine companies

studied. This may be solved, however, by designing ERP applications locally and customizing them for each particular industry. This would entail, though, a substantial amount of study per industry–the cost in time these companies are reluctant to spend on.

One would also notice that ERP has always been associated with vendors such as Oracle, SAP, and PeopleSoft. If ERP is viewed more as a concept, more companies in the Philippines, even smaller ones, can implement it locally, not just the big enterprises which are financially capable of sustaining it.
Based on the experiences of selected companies, Table 4 shows the factors that drive and restrain Philippine business enterprises from adopting ERP.

As shown in the table, the factors that ensure successful ERP adoption among Philippine business enterprises are: management support; involvement of organizational members from all ranks in the planning and implementation stages; vendor support; and user education.

Those that inhibit ERP application are: high cost; lack of appreciation of the software; difficulties in application to the local environment; and the question of sustainability given the situation of these companies, which are essentially in a transition stage. Most of the companies studied are undergoing mergers, separation from parent companies, and takeovers. While ERP is used as a planning tool, the question that arises is: how can a company effectively plan if the status of the organization itself is uncertain?

On a larger scale, the state of the national economy also has an effect on the sustainability of local companies, which in turn spells the future of ERP implementation by Philippine business enterprises. During the Estrada administration, for instance, the Philippine economy suffered heavily–first from the Asian financial crisis, after which low investor confidence marked the end of 2000 due to scandals of graft and corruption in government involving the former president. This environment generally did not augur well for business in the Philippines. For an expensive project such as ERP to be implemented by a company, much depends on the financial viability of the corporation to run it given this larger picture of the economy.

Table 4: Push and pull factors in ERP adoption

	FAIRCHILD	ISLACOM	CPPC	STERLING TOBACCO
PUSH FACTORS	Mgmt. support Learning curve	Management support Involvement of mgmt., staff, IT on the drawing board	Management support People's will and capability to develop own system	Management and vendor support Competent people user education
PULL FACTORS	Cost Educating people Application to local	Cost Transition stage– Merger brings uncertainty	Transition stage Resource constraints	Cost Resistance to change

Table 4: Push and pull factors in ERP adoption

	FAIRCHILD	ISLACOM	CPPC	STERLING TOBACCO
	environment			

It may also be noted that the crucial factors here are not so much the technical issues but more of the organizational ones. In the Philippine setting, it seems that the technical aspects are not the overriding factors in the successful adoption of ERP. What really spells the difference are leadership/management support, funding resources, and organizational culture. The role of leadership/management is vital in affecting organizational culture change, as well as in providing funding resources to sustain ERP. Leadership/management can direct the change in assumptions, values, beliefs, and behavior of organizational members that are supportive of the ERP application and are congruent with company objectives using ERP as a tool. Moreover, the common problem of high cost can easily be remedied if ERP implementation is a management initiative, as in the case of the four companies cited. Funding support is secured if management is convinced of ERP's benefits and the project is a directive from the top.

AREAS FOR FUTURE STUDY

The case studies provide an insight on organization, which is a major consideration in the ERP discourse. Future studies should consider organizational culture adjustments needed for effective ERP implementation, especially in developing countries. Further studies may emphasize the factors affecting ERP adoption by small- and medium-scale enterprises as defined in the Philippine or Asian context. Sectoral- and industry-specific case studies may also be conducted to develop models illustrating ERP's contribution to raise Asian firms' competitive advantage.

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Chapter V: The Impact of Enterprise Resource Planning Systems on Organizational Effectiveness: An Artifact Evaluation

OVERVIEW

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Enterprise resource planning (ERP) systems have an organizational impact and are in most cases implemented to improve organizational effectiveness. Shortcomings in current research make it difficult to conclude how an organization may be affected. This paper presents an artifact evaluation of the functionality and perceived benefits of ERP systems. The evaluation is based on the competing values model. The evaluation shows that ERP systems support effectiveness criteria (such as control and productivity) related to internal process and rational goal models. The evaluation also points out weaknesses in ERP systems and especially in areas related to human relations and open systems models. The result of the evaluation is used to discuss the impact of ERP systems on organizations and is presented as a series of hypotheses.

INTRODUCTION

The term enterprise resource planning (ERP) systems (also referred to as enterprise systems) is used as a generic label for large integrated application software packages. These information systems are by many regarded as a dream come true and are in most cases implemented in order to improve organizational effectiveness (Davenport, 1998; Davenport, 2000; Markus & Tanis, 2000). Studies show improved organizational effectiveness such as business process improvement, increased productivity, and improved integration between business units (Davenport, 2000). Davenport (1995, p. 32) described the implementation of ERP as "*perhaps the world's largest experiment in business change*" and for most organizations "*the largest change project in cost and time that they have undertaken in their history*." The same studies also described cases where the implementation failed and the impact had the opposite affect on organizational effectiveness. The only thing known for certain is that implementation is very resource-consuming. The impact and benefit of the implementation is unclear (Andersson & Nilsson, 1996).

The ability to determine the impact of such systems on organizational effectiveness would be of great importance from both theoretical and practical perspectives. However, this determination is difficult for several reasons: 1) it is not possible to draw an explicit conclusion from the IS benefit research (e.g., DeLone & McLean, 1992; Seddon, Staples, Patnayakoni, & Bowtell, 1999) on the impact of ERP systems; 2) the inconsistent and contradictory findings from research on information technology and organizations

(Robey & Boudreau, 1999); 3) The lack of research on ERP systems (Shanks, Seddon, & Willcocks, 2001) makes it difficult or even impossible to draw conclusions with regards to a specific organization; 4) the complexity and comprehensiveness of ERP systems as such; and 5) the measurement of the effectiveness of an organization is an elusive, complex and socially constructed concept (Campbell, 1977).

The objective of this chapter is to evaluate the functionality of ERP systems in order to increase the understanding of how ERP systems may affect organizations and organizational effectiveness. The next section introduces changes in the requirements specification and arguments from IS research as a background for conducting an artifact evaluation of ERP systems. The subsequent sections present the interpretive artifact-evaluation approach, with an evaluation framework based on the competing values model (Quinn & Rohrbaugh, 1981, 1983), the ERP system in question (SAP R/3), and the outcome of the evaluation. In the final section the results are summarized and presented as a series of hypotheses speculating how ERP systems might affect organizations and organizational effectiveness. Future research directions are also suggested.

BACKGROUND

The requirements specification is a problematic area in most IS implementations (Jackson, 1995) since "*we have a tendency to focus on the solution, in large part because it is easier to notice a pattern in the systems that we build than it is to see the pattern in the problems we are solving that lead to the patterns in our solutions to them*" (Ralph Johnson in Jackson, 1995, p. 2). This applies in particular to the implementation of ERP systems (Borell & Hedman, 2000; Rolland & Prakash, 2000). One of the reasons for this is the difference between implementations, based on the comparison of traditional information system development methods and the process of selecting and implementing ERP systems. Where it no longer appears meaningful to speak about analysis and design in a traditional fashion, because there is no analysis and design process as such. Instead, an evaluation of the reference model is made and the functionality imbedded in the ERP system is considered, followed by a selection process. For each ERP system (or part of an ERP system) considered, there are three basic options: accept, accept with changes, or reject–all with different organizational consequences. These options must be considered in light of the requirements specification, which in turn has to reflect this (Borell & Hedman, 2000). These differences are illustrated in Figure 1. This line of reasoning is also applicable to implementations of upgrades and extensions.

Traditional	ERP system
User	Designer
Designer	System
System	Organization

Figure 1: Comparison of traditional information system development methods and the process of selecting and implementing ERP systems

Another reason for writing this chapter on evaluating ERP systems comes from the conceptual thinking of IS researchers, such as Hirschheim and Farbey. Hirschheim and Smithson (1999) conclude in their literature survey of IS evaluation that the focus on tools and techniques from a positivistic approach has provided the foundation for traditional IS evaluation. The result has been "*a more 'technical' interpretation of evaluation*" (Hirschheim & smithson, p. 402)–partly because of the widespread belief that IS are fundamentally technical systems. They argue that omitting the social domain makes it unlikely to produce a true or meaningful evaluative picture and that a more interpretive IS perspective seems to be the best vehicle for doing so.

Farbey, Land, & Targett (1995) propose a model known as the benefits evaluation ladder, which they claim relates specifically to the need for evaluation. They argue that two of the most influential factors when selecting an evaluation method are application and objective (of change). A classification of "*the uses of information systems may therefore be of fundamental importance in selecting suitable evaluation methods*" (Farby et al., 1995, p. 41). Their model is based on the perception that it is possible to classify the different IS applications based on the different types of organizational change that they are associated with. It consists of eight rungs, including mandatory changes, automation, direct value added systems, MIS and DSS, infrastructure, interorganizational systems, strategic systems, and business transformation. Their classification is not rigid but implies that higher levels of change increase the levels of potential benefit as well as the uncertainty of outcome. Potential benefits and the level of uncertainty are both cumulative, thus systems classified on a certain stratum may have all the benefits (and accumulated uncertainty) from any or all of the strata below. They conclude that for the implementation of systems on the eight rung *"benefits stem from the transformation as a whole. IT provides only one component of what is often a complex series of changes. It is not possible to attribute a portion of the benefits gained to any one factor*" (Farbey et al., 1995, p. 49). We conclude that in the taxonomy of Farbey et al., ERP systems are on the eight rung and that they have the possible benefits and accumulated uncertainty of all the strata below. Therefore, it is highly unlikely that any two implementations will have identical requirements or consequences, even if they are based on the same generic software packages. While the potential benefits might be articulated, determination of the actual benefits from implementing an ERP system is difficult to foresee.

McKeen and Parent (1999) proposed a "supra-framework labelled Organizational Economics." They propose that their model "*can apply to all sorts of projects and organizational forms*" (p. 13) and suggest that IT investments can be considered as part of a chain of events: a senior management decision ('IT Governance') has to be made that leads to a specific *investment* in IT, which then needs to be *deployed* (selected and implemented) before it can be *used* by an organization to enhance its *performance*. In their first postulate, McKeen et al. (2000) state that "*With the focus at the enterprise level, it should be possible to capture the effects of the total IT investment on the organization's performance provided that the performance measure is related to the usage of the technology"* (p. 15). The delimitation of level of analysis to an entire enterprise is based on the anticipated possibilities to obtain relevant measurements of cost and performance combined with a holistic perspective on the decision process. Investing in an ERP system is a top-management decision. It will have an impact on the culture, processes, structures, and strategies of an organization (Davenport, 1998) and therefore the only suitable level of analysis is the enterprise level.

ARTIFACT EVALUATION

An evaluation of the impact of ERP systems on organizational effectiveness is difficult. Some of the problems which arise are the complexity and comprehensiveness of ERP systems, the lack of empirical research on the impact of ERP systems on organizational effectiveness, and the shortcomings of traditional multivariate methods (such as factor analysis) for solving problems related to organizational effectiveness (Campbell, 1977). Thus, following Hirschheim and Smithson (1999), we approached the problem in an interpretive way by applying an artifact-evaluation approach. This research approach belongs to a research stream stressing artifact utility, which can be broadly dived into artifact-building and artifact-evaluation approaches (Järvinen, 1999, 2000). Although critical, it is not well-represented in IS research (Järvinen, 1999, 2000; Lee, 2000; March & Smith, 1995). An artifact can be a construct (concept), model, method, technique, instantiation of an information system, or an ERP system. In artifact-building research, the focus is on questions such as: Is it possible to build a certain artifact; how should a certain artifact be defined and how can we develop it? In evaluation research, questions like how effective and efficient is this artifact are posed and addressed. For this one needs both criteria and measurements to evaluate the effectiveness and efficiency of the artifact. To this end we chose the competing values model (CVM; Quinn & Rohrbaugh, 1981, 1983). There were three main reasons for this choice: First, it is a well-established framework developed and empirically tested in organizational research (Buenger, Daft, Conlon, & Austin, 1996), management research (Hart & Quinn, 1993), and IS research (Sääksjärvi & Talvinen, 1996) over a number of years. Second, it is related to the critical constructs of individual and organizational effectiveness. Third, it is addressing the organizational level of analysis. Later versions and extensions of CVM for assessing management competence and diagnosing organizational culture were assessed, but they were not found to be appropriate for this evaluation due to their shortcomings regarding lower-level efficiency.

Competing Values Model

Until the development of contingency theory, organizational effectiveness was perceived as an applied area, not a theoretical issue in organizational theory. Contingency theorists' addition to the development of organizational effectiveness as a theoretical issue was arguments that some organizational structures were more suitable than others to certain tasks and environments, i.e., contingency factors (Scott, 1992). The question that followed was–suited in what sense? The answer given to this question in most cases was in terms of effectiveness (Scott, 1992) or performance (Olerup, 1982).

Traditionally, organizational effectiveness was defined as meeting or surpassing organizational goals (Bedeian, 1987). The goal approach has dominated organizational effectiveness studies despite criticisms (Hall, 1980) that organizations have multiple goals (Cameron, 1981) and that criteria for measuring effectiveness are ambiguous (Meyer, 1985). Alternative approaches to organizational effectiveness studies have emerged to deal with both these problems and others, e.g., the resource approach (Cunningham, 1978), the internal process approach (Ostroff & Schmitt, 1993), the stakeholder approach (Tusi, 1990), and the competing values model (Quinn & Rohrbaugh, 1981, 1983). Despite these efforts, it is still difficult and potentially controversial to quantify (Cameron & Whetten, 1983). Effectiveness criteria can be described in very general and broad terms, e.g., survival or profit, or in more narrow terms based on functions, hierarchical levels, roles, or processes in organizations based on the participants and constituents. The complexity of the concept of organizational effectiveness can be illustrated by Campbell's (1977) list of 30 different criteria for

measuring organizational effectiveness, ranging from job satisfaction to growth and productivity. With regard to this, CVM is especially notable, since it combines diverse indicators of effectiveness and performance.

The competing values model is based on the hypothesis that there is a tension between underlying value dimensions (Quinn & Rohrbaugh, 1981, 1983). The first value dimension is focus–internal focus puts emphasis on the well-being of the organization itself while external focus is placed on the organization within its environment. Structure is the second value dimension–stability refers to the need for top management control, and flexibility refers to the need for adaptation and change in organizational structure (Quinn & Rohrbaugh, 1981, 1983). The measures that underlie the value dimensions reflect one of four organizational models: human relations model (HR), open systems model (OS), internal process model (IP), and rational goal model (RG). A critical point to note is that while different organizational models reflect different effectiveness criteria, they are not dichotomic. Effectiveness may require that organizations are both flexible and stable, as well as have a synchronous internal and external focus (Quinn & Cameron, 1988). The models reflect opposing views of organizational effectiveness simultaneously.

The HR model focuses on internal flexibility to develop employee cohesion and morale. It stresses human resource development, participation, empowerment, team building, trust building, conflict management, supporting, communication internally, developing individual plans, feedback to individuals and groups, and developing management skills (Quinn, 1989).

The OS model focuses on external flexibility and suggests readiness and flexibility as the reasons by which growth may be gained. Important issues are the acquisition of scarce resources, support of interaction with the external environment, identification of major trends, development of business intelligence, creation of mental models, facilitation of changes, dedication to research and development, identification of problems, influence the environment, and maintenance of external legitimacy through a network of external contacts (Quinn, 1989).

The IP model focuses on internal stability and uses information management, information processing, and communication to develop stability and control. This is done by collecting data (mainly internal quantitative information used to check organizational performance), enhancing the understanding of activities, ensuring that standards, goals, and rules are met, maintaining organizational structure and work flow, coordinating activities, and collecting and distributing information internally (Quinn, 1989).

The RG model is characterized by a focus on external control and relies on planning and goal setting to gain productivity. This includes clarification of expectations, goals and purposes through planning and goal setting, definition of problems, generation and evaluation of alternatives, generation of rules and polices, evaluation of performance, decision support, and quality control, motivation of organizational members to enhance productivity, sales support, and maximization of profit (Quinn, 1989).

A summary of the four organizational models (HR, OS, IP, and RG), the value dimensions, and related measures of organizational effectiveness is depicted in Figure 2. The value dimensions and the related organizational models should not be directly compared to the major organizational perspectives that exist in organizational theory;

namely, rational, natural, and open. Take for instance the open system perspective, which views organizations as open systems but also emphasizes information processing, which relates to the internal process model in CVM.

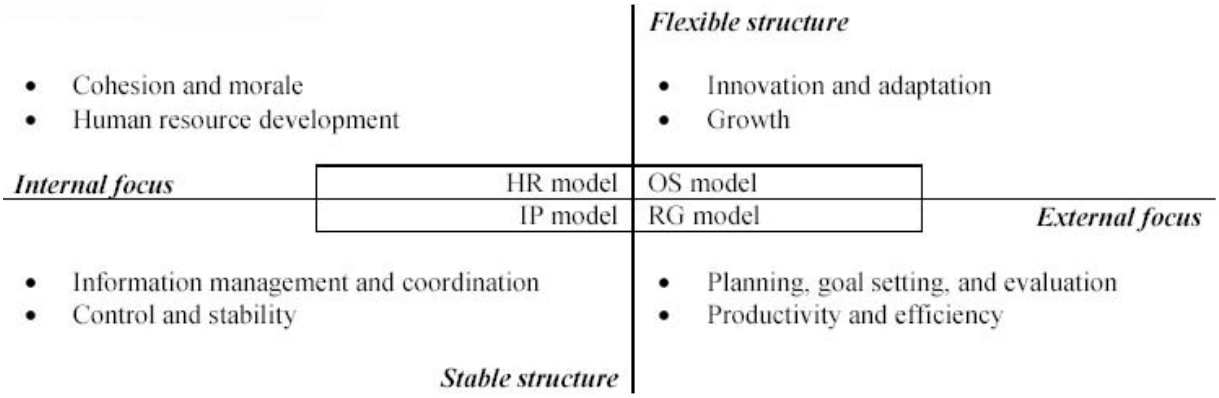

Figure 2: Competing values model (Quinn & Rohrbaugh, 1981, 1983; Rohrbaugh, 1981)

Since Quinn and Rohrbaugh's initial studies, the use of CVM has evolved to become a general framework for organizational and management research. It has been used to study executive leadership and assess overall organizational effectiveness (Hart & Quinn, 1993); organizational life cycles (Quinn & Cameron, 1983); organizational forms (Quinn & Hall, 1983); organizational culture (Cameron & Quinn, 1999); and the relationship between environment, technology, values, and structure (Buenger et al., 1996). Several researchers in the IS community have also used CVM as a general frame of reference. Carlsson and Widmeyer (1994) used CVM as a base in a conceptual research model of ESS. Sääksjärvi and Talvinen (1996) used CVM to evaluate the perception of organizational effectiveness in the use of marketing information systems. Over the years, there have been small changes in value dimensions. Quinn and Rohrbaugh (1981) described three value dimensions: structure, focus, and time. Then in 1983, the same authors described slightly different value dimensions: structure, focus, as well as means and ends. It is a small difference, but it is important to notice since they emphasized that time is an important but neglected aspect of organizational effectiveness. Time frame is a phrase that refers to the fact that criteria for measuring organizational effectiveness may vary dependent upon whether or not a relatively short or long time frame is adopted and that organizations in different life cycle stages naturally change their measures of effectiveness.

ERP Systems–SAP R/3

For the evaluation of the impact of ERP systems on organizational effectiveness, we chose SAP R/3 version 4.0b IDES, which can be viewed as a reference system and is used for training and educational purposes. It represents roughly 50% of the total functionality and processes supported by the system. We chose SAP R/3 because of the large amount of documentation available in books, research reports, academic publications, and R/3 extended help and the availability of SAP R/3 thru the SAP University Alliance program. Other ERP systems vendors, such as Baan, J.D. Edwards, Oracle, and PeopleSoft do not have the same richness of documentation.

ERP systems are large integrated computer software packages consisting of components, each with a given set of functions. All available functions operate on a shared set of data, thereby achieving integration. The idea of these systems is to support every single aspect of organizational storage, processing, retrieval, and

distribution of data. This is supposedly done without regard to organizational scope, business, or comprehensiveness–at least that is what the vendors say. In that sense, an ERP system is a generic solution with different levels of adaptability, which make every implementation unique in some sense since an organization must configure the system to its own specific requirements. In many cases, the system is customized to special requirements that are not supported by R/3. One of the attractions of ERP systems is the value of integration. There are other perceived (the reason for describing ERP systems benefits as perceived is due to the lack of research in the field. We don't believe there is enough evidence in the research conducted up to now to state, "ERP systems lead to organizational improvements") benefits associated to ERP systems including business process improvement, integration among business units, real-time access to data and information (Davenport, 1998), standardization of company processes, increased flexibility, increased productivity, increased customer satisfaction, optimized supply chain, business growth, improvement of order-to-cash time, competitive positioning ability, shared services, improved time-to-market cycles, and improved product quality (Cooke & Peterson, 1998). To summarize, ERP systems can support an organization in six main ways:

- First, they support organizations by integrating information flows (such as customer information, financial and accounting information, human resources information, and supply chain information) and making it available to the entire organization (Davenport, 1998).
- Second, they integrate diverse primary business activities, functions, processes, tasks, and work flows (such as accounting, finance, and procurement) as well as secondary activities with primary activities (such as inventory management; Davenport, 1998).
- Third, they serve as a common data repository (master data) for organizations (Scheer, 1998). A data repository for an organization is that it may define the format of the data, which makes communication and interpretation of easier.
- Fourth, they specify how organizations should conduct their business based on a best business practice reference model (Kumar & Van Hillegersberg, 2000).
- Fifth, they reduce the number of logical computer based information systems (Joseph & Swanson, 1998) and replace old legacy systems (Markus & Tanis, 2000).
- The last and maybe the most obvious support is that they deliver functionality per se. This functionality supports the core business processes (such as sales and marketing, procurement, and production) and support processes (such as controlling, human resource, and finance) of an enterprise. In the case of SAP R/3, the functionality is divided into three groups: accounting, logistics, and human resource (Keller & Teufel, 1998). A full description of this functionality can be found at http://help.sap.com/fb/English.htm. In addition, there are user administrative tools, database administration tools, e-mail, appointment calendar, functionality for room reservations and ordering food, a software development workbench, telephone integration, work flow system, and an executive information system.

To achieve these benefits from an ERP implementation, organizational changes are required (Van Der Zee & De Jong, 1999), which are prompted by business process reengineering (Bancroft, Seip, & Sprengel, 1998), organizational transition to an ERP

system, retraining of entire departments, job redefinition (Deutsch, 1998), and transformation of core processes (Caldwell & Stein, 1998). ERP systems are often thereby assumed to be a deterministic technology, since organizations have to align their business process to the embedded business processes representing best practice, which are assumed to generate organizational change (Glass, 1998). However, this transformational power has been questioned (Boudreau & Robey, 1999).

Procedure

The evaluation of ERP systems was performed in a three-step process. First, we listed the functionality of the ERP system and reported benefits associated with ERP systems. Then we categorized ERP capabilities with respect the value dimensions–internal vs. external and stable vs. flexible. The third step was to classify each ERP system's functionality to CVM with regard to the value dimensions. The authors performed the evaluation and classification independently. The classification and evaluation outcomes were then compared. There was substantial agreement, approximately 90%, between the evaluations (some functionalities were question-marked in the evaluations). Where disagreements existed, the functionality was reevaluated and a final classification and evaluation decision was made which satisfied both authors. To some extent, we verified the classification from published articles on ERP systems' benefits, but in most cases this was not possible. This is because most research on ERP systems does not describe the ERP functionality to such a detail that it is possible to verify the classification.

This approach has its drawbacks. For example, production planning is essential to manufacturing firms; it is of little or no value to retail firms. Also, regarding the impact of the environment and technology of the user, some capabilities are more important than others depending on the environment and technology of the organization in question. An accountant does not need production planning functionality. Finally, in terms of the number of users of each function in an organization, it's likely to assume that some functionalities will have several users, e.g., a firm will have several salespersons.

OUTCOME AND DISCUSSION OF THE EVALUATION

While most of the functionality and the benefits map to either the IP model or the RG model, some of the functionality is interpretable as belonging to both models. This is due to the fact that system functionality supports several organizational functions with different effectiveness metrics. Accordingly, ERP systems and perceived benefits relate to IP- and RG-associated organizational goals and effectiveness metrics. Hence, ERP systems primarily support tasks related to control, efficiency, productivity, and stability by improving information management, coordination, and planning. The strong support of the IP model is natural since ERP systems (as most IS, e.g., MIS, controlling systems, and inventory systems) are internal systems that are designed to support the internal processes and functions of organizations. Another important and critical functionality is the creation of master data records for customers and vendor. This functionality is used as a repository for data and makes it possible to communicate information through an organization. This is what makes integration of information and processes possible. However, the lack of support for HR and OS models was surprising. The outcome of the classification and evaluation of the functionality and benefits of ERP systems is presented in Figure 3.

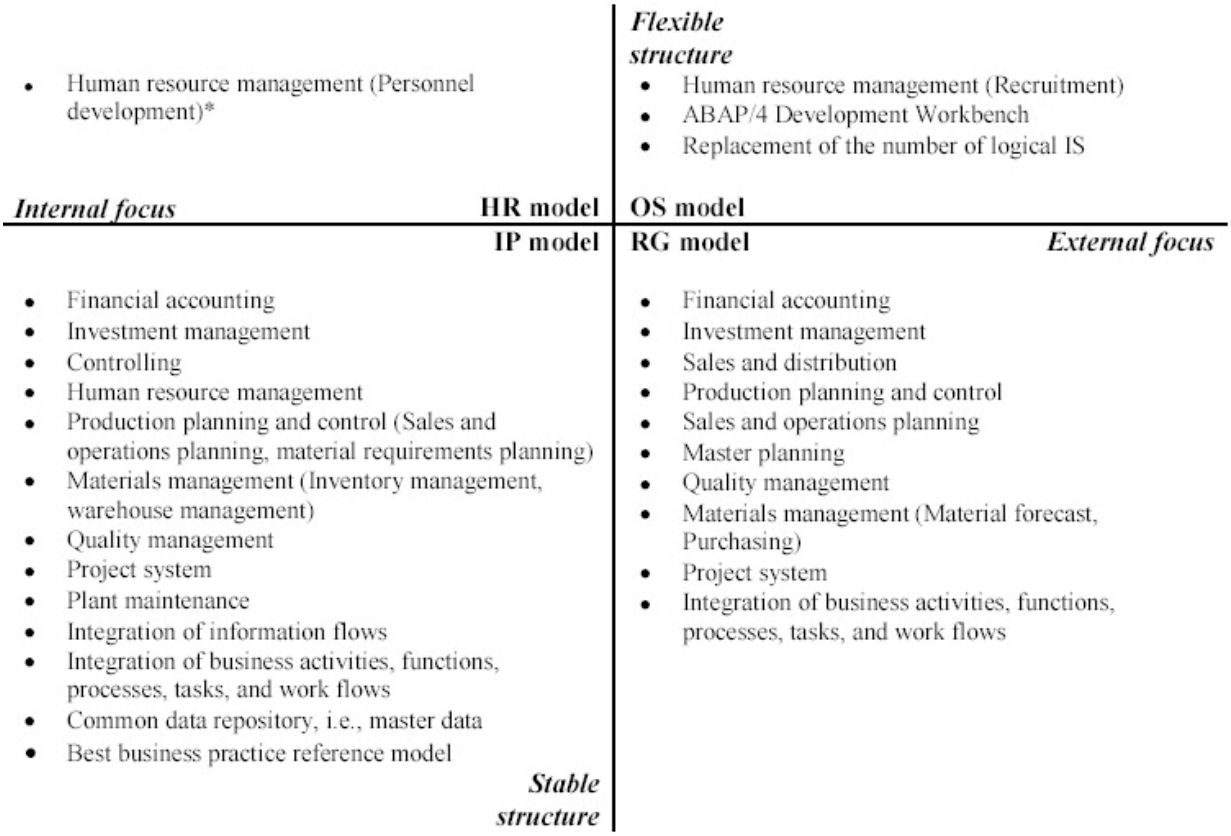

Figure 3: Mapping of ERP system capabilities into CVM

The artifact evaluation of the ERP system shows the existence of an in part implicitly shared framework with CVM. This, combined with research performed on CVM, makes it possible for us to draw conclusions, which we present as a series of hypotheses that predict the impact of ERP systems on organizations and organizational effectiveness.

The first conclusion regarding ERP systems such as R/3 is that there is a lack of support regarding HR- and OS-model effectiveness constructs, i.e., an unbalanced support of organizational effectiveness. Such a suggestion is based on the idea that well-balanced support is generally beneficial, and that an organization must simultaneously attain several different and possibly contradictory goals to become effective (Campbell, 1977). Predictions about ERP systems' impact on organizations form our first hypotheses.

- Hypothesis 1a. ERP systems will impact organizations and improve those areas that are tied to organizational effectiveness measures related to IP and RG models.
- Hypothesis 1b. An organization with certain organizational effectiveness requirements must seek capabilities in the corresponding quadrant, which requires an evaluation of the organization's effectiveness requirements.
- Hypothesis 1c. A successful implementation of ERP systems has to be followed by organizational change efforts that will improve organizational effectiveness associated to IP and OS models, i.e., human resource development flexibility and adaptability.

- Hypothesis 1d. Organizations with an identified effectiveness focus in the human resource model or the open system model will become less effective if they implement an ERP system.

Studies within the CVM framework suggest that all effectiveness constructs are not equally important and critical at the same time. There are changes in the importance of the effectiveness constructs in relation to hierarchical levels and what stage of the life cycle a firm is in. With regard to the CVM framework, Quinn and Cameron (1983) found four different stages a firm can be in: 1) entrepreneurial, 2) collectivity, 3) formalization and control, and 4) elaboration of structure stage. The critical effectiveness constructs of the entrepreneurial stage lie in the OS model, while the critical effectiveness constructs of the collectivity stage lie in the HR model. In the formalization and control stage, the effectiveness constructs are based on the IP and RG models. The elaboration of structure stage has a more balanced emphasis upon the effectiveness constructs. The following hypotheses predicts the influence what stage in the life cycle a firm is in on the impact of ERP systems on organizations.

- Hypothesis 2a. For organizations in the entrepreneurial or collectivity stage, ERP systems are less beneficial, since they do not provide support for their critical effectiveness constructs, i.e., cohesion, morale, human resource development, innovation, adaptation, and growth.
- Hypothesis 2b. Organizations in the formalization and control stage as well as the elaboration of structure stage will be effectively supported by ERP systems since they give good support to those effectiveness constructs.
- Hypothesis 2c. Organizations that are in the process of moving from the collectivity stage to the formalization and control stage could use an ERP system implementation to impose the structures and formalization needed in that stage.
- Hypothesis 2d. The probability of success of an ERP system implementation will differ depending on the current position of the organization in its life cycle. Most likely to achieve success are those organizations that are in the formalization and control stage.

In another study, it was found that there is also a difference in the importance of the effectiveness constructs in relation to hierarchical levels (Quinn, 1989). The two major findings in the study were that: 1) there exists an equal emphasis for the IP- and RG-related effectiveness measurers, and 2) the importance of the OS models increases at higher hierarchical levels. In relation to our evaluation of ERP systems, these findings lead to the following hypotheses:

- Hypothesis 3a. ERP systems will provide support for middle- and lower-level managers.
- Hypothesis 3b. ERP systems do not provide sufficient support for top-level mangers.

A question arose regarding SAP R/3–is it effective or not? This of course depends on various contextual factors, e.g., the stage of the life cycle and hierarchical level, which have to be addressed separately. However, it is obvious that R/3 version 4.0b does not

support top-level managers, expansion and growth of a firm, or the way a firm builds its corporate culture. That said, SAP has responded to some of these weaknesses. Lack of management support has been addressed through Management Cockpit, a multidimensional executive information system, and drill-down possibilities have been provided in their Data Warehouse solution. The lack of flexibility and shortcomings regarding connections to the external environment is to some extent addressed by the Enterprise Portal (mySAP Workplace). Increased compatibly is provided by BAPI's (Business Application Programming Interface) predefined interfaces for communicating with other applications. One area, human resource development, is currently not well supported by SAP's ERP system, and we are not aware of any major initiative by SAP to address this issue.

CONCLUSION

This chapter presents an artifact evaluation of an ERP system using an accepted framework of organizational effectiveness. The purpose of the evaluation was to improve the understanding of how ERP systems may or may not impact organizational effectiveness. The evaluation demonstrates both strengths and weaknesses of ERP systems. The strength of an ERP system is mostly related to the IP and RG models and the shortcomings are related to the HR and OS models.

In a real case situation our method must be complemented with both formal and informal methods and techniques. One such method or technique is the "competing values organizational effectiveness instrument" (Quinn, 1989)–the instrument measures perceptions of organizational performance. By applying said techniques and methods, it is possible to assess how different organizations perceive effectiveness constructs as well as what they perceive as critical for that organization (Cameron & Quinn, 1999). Together these instruments and supplementary ways may be used to develop a recommendation for how competing values should be changed and how an ERP system can support different organizational effectiveness measures.

Future research on ERP systems will include the development of instruments to diagnose organizations' effectiveness constructs and in particular this must include the development of computer-based support for this. This will enable us to determine the critical effectiveness constructs of an organization, which can be mapped to ERP systems. Future research will also include empirical studies addressing the relationship between ERP system use and support for organizational functions and processes and how this is linked to individual and organizational performance. The result can improve the ability to design and configure ERP systems and prescribe how ERP systems can be used to improve organizational effectiveness.

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Chapter VI: Enterprise Resource Planning and Knowledge Management Systems: An Empirical Account of Organizational Efficiency and Flexibility

OVERVIEW

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Enterprise resource planning (ERP) and knowledge management (KM) systems promise organizations the benefits of enhancing competitiveness and continuous revitalization. This chapter compares the characteristic differences and similarities between the two initiatives and examines how they influence organizational efficiency and flexibility when implemented within a global engineering firm. We suggest that the two initiatives are conceptually complementary but can only create a synergy when the design of organizational routines and practices fits into the meta-routines imposed by ERP and KM, and the social processes are nurtured within functions and cross-functionally.

INTRODUCTION

Two new organizational initiatives can be identified that are being or have been widely implemented. The first is ERP systems (Cerullo & Cerullo, 2000) and the second is knowledge management (KM) systems (Davenport, De Long, & Beers, 1998). ERP systems are sold as a vehicle for integrating the core business activities of an enterprise, such as finance, logistics and human resources. They are based on developing common IT infrastructures and business processes where previously, especially in large globally distributed corporations, many systems and processes coexisted, making integration very difficult. The suggestion is that these systems can play an important part in leveraging organizational competitiveness through improving the way in which strategically valuable information is produced, shared and managed. Through improving these processes, organizational efficiency should be enhanced. KM systems emphasize how firms can enhance competitive advantage through the more effective utilization of their knowledge assets through allowing free flow of knowledge across organizations (Birchall & Tovstiga, 1999; Brand, 1998; Starbuck, 1992). Through improved knowledge sharing and knowledge creation, flexibility should be enhanced.

While prior studies have provided useful insights on each of these initiatives independently, few empirical studies take into account both initiatives and investigate their influence on organizational efficiency and flexibility. In this paper we examine the

extent to which these two initiatives, when enacted within a single organization, are complementary or contradictory, and how the combination of the two influences organizational efficiency and flexibility.

Conceptual Foundations

The ability of firms to effectively respond to environmental opportunities, while simultaneously developing efficient internal processes, has long been seen as central to an organization's success (Geletkanycz & Hambrick, 1997; Volberda, 1996). A large body of literature has, thus, focused on examining the interface between the external environment and internal organizational processes, providing theoretical explanations that pinpoint the needs for efficiency and flexibility (e.g., Davidow & Malone, 1992; Wright & Snell, 1998), and more critically, a trade off between them (Ghemawat & Costa, 1993).

Influenced largely by the information processing paradigm, one stream of theoretical development has tended to focus on improving efficiency through the continuous accumulation of information (e.g., Cyert & March, 1963; Epple, Argote, & Devadas, 1996). Others have emphasized the importance of organizational design for improving efficiency (e.g., Galbraith, 1977; Lawrence & Lorsch, 1967). This emphasis on efficiency has been repeatedly reinforced by contemporary management theories and practices, notably the implementation of total quality management (TQM; Zbaracki, 1998) and the adoption of information technology (IT; Frohlich & Cixon, 1999). A more radical approach is seen in the literature on business process reengineering (BPR; e.g., Davenport, 1993), which advocates that the enhancement of efficiency depends on radically altering routines and practices around processes rather than around traditional functional structures. This is supported by the adoption of IT. More recently, as organizations' dependence on IT for revitalization grows (Orlikowski & Robey, 1991), ERP systems have been strongly promoted. ERP systems, as marketed by their suppliers, promise improvements in competitiveness through increasing productivity, cost reduction, improving decision quality and resource control, so enabling leaner production (*Communications of ACM*, 2000; Palaniswamy & Frank, 2000). In other words, ERP systems are promoted as systems that will improve organizational efficiency through both enhanced information capture and organizational redesign.

Meanwhile, conceptual arguments about flexibility posit that it can only be achieved at the cost of efficiency (Hannan & Freeman, 1989). Approaches to improving flexibility have tended to emphasize the need for cross- departmental collaboration and communication to mitigate environmental uncertainty through the adoption of organic organizational structures (Argote, 1982; Burns & Stalker, 1961). Empirical research has thus emphasized how flexibility is achieved when organizations interact with their environment. This is illustrated in approaches such as strategic choice (e.g., Geletkanycz & Hambrick, 1997), absorptive capacity (Cohen & Levinthal, 1990) and boundary spanning (e.g., Tushman & Scanlan, 1981). In conjunction with this, some have focused on the essence of continuous organizational renewal and evolution, as reflected in the concepts of organizational learning (Senge, 1990), virtual organization (e.g., Davidow & Malone, 1992) and innovation (e.g., Clark & Staunton, 1989; Douherty, 1992).

Moving beyond the polarity of efficiency and flexibility, some current literature has suggested that it is possible for organizations to enhance efficiency while at the same time allowing for flexibility. Some of the empirical accounts include the importance of

meta-routines in facilitating nonroutine work as reported by Adler, Goldoftas, and Levine (1999), the joint tasks of exploitation and exploration of knowledge proposed by March (1991) and resource recombination for innovation as argued by Galuni and Rodan (1998). Moreover, researchers have found considerable empirical evidence to support the argument that cross-functional or departmental knowledge integration facilitates the mutual reinforcement of efficiency and flexibility (e.g., Demsetz, 1991; Kogut & Zander, 1992; Pisano, 1994). The need for cross- functional knowledge integration coincides with the growing number of firms, which systematically manage their knowledge through initiatives, such as appointing a chief knowledge officer (Earl & Scott, 1999), developing a KM strategy (Hansen, Nohria, & Tierney, 1999) and implementing a KM system (Davenport & Prusak, 1998).

So, in the literature we have those who argue that efficiency and flexibility are mutually exclusive, while others argue that they are perfectly compatible. At the same time, in practice we have companies that are implementing, often simultaneously, ERP systems that focus on improving efficiency and KM systems that focus on flexibility. In this paper we consider a company that is indeed implementing these two initiatives simultaneously in order to explore whether they are in practice complimentary or contradictory. Given the lack of previous empirical research, this is considered to be an important area of investigation. Specifically, this chapter reports an empirical study that explored the interrelationships between ERP, KM and organizational efficiency and flexibility. The study aimed to answer the following three research questions: (1) What are the similarities and differences between ERP and KM in terms of their characteristics? (2) How do ERP and KM influence each other when they are implemented within a single organization? (3) How does the combination of ERP and KM influence organizational efficiency and flexibility?

RESEARCH CONTEXT AND METHODS

Guided by the above research questions, empirical research based on the case study approach (Stake, 1995; Yin, 1984) was conducted between 1998 and 1999 to generate in-depth insights. Company A,[1] a top-league multinational player in the engineering industry, designs and manufactures standard and custom-built products and provides consulting services for corporate clients across the globe. The case company started its global ERP implementation during the third quarter of 1995 and completed it during 1998. The implementation of ERP was facilitated by Firm Z, a leading IT service provider and long-term strategic partner of Company A. During the implementation of ERP, in late 1997, another critical company-wide initiative–knowledge management–was started. The implementation of KM encompassed various initiatives, such as forming a project team and steering group, identifying stakeholder groups, building a corporate-wide knowledge directory and KM Web site on the firm's intranet, and training courses and workshops.

Three sources of evidence were collected from 37 interviews (25 first interviews and 12 follow-up interviews), on-site observation, and examining documentation, including written reports, administrative documents, archives and newsletters. Multiple data collection methods were employed not only for the purposes of enhancing the richness of findings, but also for the process of triangulation as a means of ensuring the validity of the findings (Bryman, 1989; Denzin, 1988; Yin, 1984). Data collected from these sources was then analyzed based on the coding techniques proposed by Miles and Huberman (1994) and Strauss and Corbin (1990). Emerging insights were iteratively compared with the current literature for the purposes of identifying and articulating

theoretical similarities and differences. The following section outlines the research results derived from the analysis.

[1]Names of the case company and consulting firm have been disguised.

ANALYSIS AND DISCUSSION

Guided by the proposed three research questions, the following discussion is structured as follows. To start with, the characteristic differences and similarities between ERP and KM systems, at least as enacted in the case company, will be addressed. Following that, the relationship between ERP and KM will be examined based on a theoretical framework provided by Pettigrew and Whipp (1991). The analysis of content, context and process further leads to the discussion of how ERP and KM individually and collectively influence organizational efficiency and flexibility by building upon the theoretical argument of Adler et al. (1999).

ERP and KM: Differences and Similarities in Characteristics

With a common goal of improving profitability and competitive advantage, these two initiatives were considered to be two major milestones for the company for radical process innovation. The main objective of ERP is to improve productivity and product efficiency through the effective management of data and information, as well as a closer monitoring and continuous improvement of production input, processes and output. In other words, the adoption of ERP in this case mirrors some other empirical studies that emphasize holistic improvement of efficiency through cost reduction, enhancing decision quality and increasing productivity (e.g., Scott & Kaindl, 2000; Soliman & Youssef, 1998).

In comparison to ERP's production orientation, KM in the case company concentrated on the utilization of knowledge that was applied for product and process innovation. Particularly, the emphasis on continuous learning and benchmarking, at the individual and departmental levels, was found to be an alternative approach to improving productivity, and a critical source for organizational renewal (Jones & Hendry, 1994). In terms of knowledge codification, KM was designed and implemented to facilitate knowledge sharing across the case company's global operation to avoid "reinventing the wheel" (Brown & Woodland, 1999; Gurteen, 1998). However, more critically, such a codification effort aimed to clearly list technological solutions and know-how so that it was apparent which intellectual capital rights do not exclusively belong to the case company. For instance, some of the new designs or technological solutions created by the consultancy division were based on clients' know-how and were registered by the client. Legitimately, knowledge created on such a basis cannot be further applied in the case company or in behalf of other clients. Hence, in this company the KM initiative focused not only on avoiding repeated efforts in creating similar solutions or designs but also on avoiding illegal acts which employees might mistakenly make by using a solution that actually belonged to a client company. This was a distinctive characteristic of the KM initiative in Company A that differs from other cases, such as 3M (Brand, 1998), Buckman Lab (Pan & Scarbrough, 1999) and Celltech (McNamara & Baden-Fuller, 1999).

A key feature of the ERP system adopted in the case company was the establishment of a corporate-wide common IT infrastructure, which upgraded and integrated existing infrastructures and systems. Along with the advancement of IT infrastructure, the case company also went through a restructuring process involving the production, logistics

and warehouse divisions. Through reducing the sheer number of warehouses (from 144 worldwide for raw materials, components and finished products at various sizes to 51), the logistics division was restructured based on regions rather than products and reported directly to the regional head offices and head office rather than production. The main reconstruction in the production division was to outsource part of the component production through original equipment manufacturing (OEM) and to focus on high value-added products, such as custom-built engines.

In contrast to radical structural changes triggered by the ERP adoption, key initiatives related to KM were comparatively incremental. In addition to various workshops and training courses for disseminating KM concepts and tools, one of the most critical steps was the organization of product-based learning and innovation communities across the global operation. In the case company, these "communities of practice" (Brown & Duguid, 1991; Wenger & Snyder, 2000) are geographically dispersed. This means that community members have to rely on ICT rather than face-to-face interaction in order to communicate and share ideas. In other words, they are arranged as virtual teams (Lipnack & Stamps, 1997).

In terms of impacts on organizational processes, the adoption of ERP led to the centralization of procurement and a reduction in the number of suppliers and service providers.[2] The rationale behind these rearrangements can be largely explained by the current advocacy of ERP, as such systems are promoted as enabling firms to synthesize internal procurement efforts and keep on track with inventory levels (e.g., Al-Mashari & Zairi, 2000; Wagle, 1998). Additionally, ERP permits the transparency of product- and production-related information across functions, particularly after integrating various systems that are function- or division-specific, such as the product data management (PDM) system of the operation engineering division. More importantly, the implementation of ERP enabled the organization to set up a single, unified productivity and efficiency measurement, which was applicable to all production sites. Furthermore, ERP also enabled the case company to continuously and systematically evaluate suppliers' and service providers' performance on a cost-efficiency basis.

This unified performance measurement was further linked to one of the KM initiatives, as the outcome of the cross-site performance comparison was used as an indicator for individuals' training and departments' learning needs. In addition to the implication for continuous learning, KM was implemented to ensure that knowledge created and acquired from organizational processes, mainly production and consultancy, was constantly captured and codified. Moreover, involving suppliers and service providers at an early stage of product and process designs allowed the company to channel external sources of knowledge into the organization (Huber, 1991). The KM initiative then improved the intra- and interorganizational integration of knowledge, allowing the firm to develop through a continuous cycle of innovation (Grant, 1996). The above discussion, related to the distinctive characteristics of ERP and KM, further surfaces the need for anticipating whether these two initiatives are complementary or contradictory.

ERP and KM: Complementary or Contradictory?

Building upon the above discussion on characteristic similarities and differences, this section examines the relationship between ERP and KM from three distinctive but interrelated dimensions, namely, content, context and process (Pettigrew & Whipp, 1991).

Content: Information vs. Knowledge

Similar to other empirical studies (e.g., Al-Mashari & Zairi, 2000; Pereira, 1999), the implementation of ERP in the case company concentrated primarily on the efficiency of producing, gathering and managing information. Efficiency improvements were sought through enhancing the information processing capability of the company, enabled by the systematization and centralization of information management and the adoption of standard approaches to the codification and processing of information. In other words, through a common IT infrastructure, information that used to be functionally concealed became available throughout the organization in a predefined format (Wagle, 1998).

Meanwhile, KM in the case company concentrated on the mobilization of knowledge through encouraging the codification of explicit knowledge and the organization of learning and innovation communities as a means of sharing tacit knowledge (Brown & Duguid, 1991; Orr, 1990). The case company's specific emphasis on knowledge exploitation (March, 1991) and distribution (Huber, 1991) suggests that the firm's creation of knowledge largely depends upon the processes of exchange and combination (Nahapiet & Ghoshal, 1998). The exchange process was facilitated through the organization of communities and the availability of a corporate-wide expertise database.

These distinctive foci and orientations indicate that ERP and KM can be conceptually complementary, because each system is designed and implemented for a clearly defined managerial purpose, notably managing organizational information or knowledge. The two systems can be mutually reinforced because it is argued that an organization's information processing capability strongly influences how knowledge can be effectively created, exploited and captured (Hackbarth & Grover, 1999; Nambisan, Agarwal, & Tanniru, 1999; Tenkasi & Boland, 1996). And the distribution and availability of knowledge determines the way in which information is interpreted by organizational members (Huber, 1991; Shrivastava & Schneider, 1984). However, such a co-relation resulting in the mutual reinforcement between ERP and KM can also mask and overlook the distinctive, and yet mutually interdependent, natures of information and knowledge. Information has to be interpreted and this interpretation will depend on one's knowledge. Knowledge, in turn, will be influenced by information one has (Galliers & Newell, 2000). The design of ERP imposes a universal frame of coding and interpreting information as a means of enhancing consistency and efficiency. As such, the information is detached from its context. However, in translating information into knowledge the context is important, since to detach knowledge from its context and conceptualize it in an abstract form might mean that it loses its meaning (Blackler, 1995) because of the socially-embedded and context- dependent nature of knowledge (Nonaka & Konno, 1998; Spender, 1996; Tsoukas, 1994). For instance, the decision about which material to select to make an engine's blades will depend on how the engine will be used (context dependent) and the technology of processing such raw material. The rationale behind the choice of material cannot be detached from its context and applied to all types of engines, simply because of their different usage. Therefore, the distinctiveness of information and knowledge not only suggests different implications and values for organizations, but also suggests that both ERP and KM are needed in order to release and leverage the respective values of information and knowledge.

Context: Intra-Organizational vs. Interorganizational

Despite the fact that both the ERP and KM initiatives aimed to break down formal departmental and divisional boundaries, the implementation of the two systems in the

case company led to an unanticipated consequence. The ERP implementation led to an emphasis on measuring physical output across the production division. Rather than increase collaboration as intended, this crystallization of individual and departmental performance in the production division was found to increase internal competition. Consequently, boundaries between different production units were reinforced, even though information flowed freely across units. This reinforcement of boundaries between units within the production division meant that knowledge sharing and integration across the division were often problematic, even though information was shared. While the creation of learning and innovation communities could have, to some extent at least, overcome these reinforced boundaries, this did not actually happen in the case company because these communities were consciously organized so that any given community did not have representation from more than one production unit. This was a political decision invoked to try to reduce conflict. As a result, however, both the ERP and KM initiatives helped to create a new boundary layer within the production division. This impeded, to some extent, the sought-after knowledge sharing and creation across the production division (Nonaka & Konno, 1998; von Krogh, Ichijo, & Nonaka, 2000). In this instance then, the ERP and KM initiatives were not mutually supportive. Rather they both reinforced the creation of boundaries within the production division.

Within the interorganizational context, one of the key issues emerging from the analysis was the changes in relationships with suppliers and service providers. Following the adoption of ERP and the strategic consideration of cost reduction, the number of suppliers and service providers was drastically reduced, removing in particular those with whom the case company had small and infrequent transactions. There were benefits from consolidating purchasing power and improving supply chain management through having fewer suppliers and service providers, as others have found (e.g., Anderson, Britt, & Favre, 1997). At the same time, however, relationships with some smaller suppliers and service providers had been vital since these organizations had been actively involved in developing new products. With the reduction in the number of suppliers, relationships with these smaller suppliers had been terminated, thus curtailing their participation in new product development. The impact of such change was foreseen by the R&D division but ignored by the majority of ERP stakeholders, mainly the board members and those from the production division. Again, however, the KM initiative did not overcome this problem but rather reinforced it. This was because one of the activities under the KM initiative was to establish and capitalize on strategic partner- ships. This was achieved by working with a much smaller number of suppliers and service providers. This was done because it was believed that only by working with a smaller number of partners could the necessary high levels of trust and integration be achieved. This activity then reinforced the approach of ERP.

Processes: Task-Related vs. Social

In terms of task-related processes, the findings suggest that the implementation of ERP had drastically improved the time to produce and gather critical information for strategic decision-making, in particular related to financial performance and productivity on a global scale (Davenport, 1998; Kumar & Hillegerberg, 2000). In addition, the implementation of KM was found to facilitate the effective and systematic exploitation of knowledge (March, 1991) intra- and interorganizationally and improve continuous learning from past actions for future actions (Fiol & Lyles, 1985).

One question that emerged is whether the improvement of organizational processes, particularly task-related ones, results from the implementation of ERP or KM or a

combination of the two. Extending the previous discussion on the orientation and focus of ERP and KM, it is clear that each initiative alone would have provided only limited potential, and value to the case company. The knowledge-based view of the firm argues that competitiveness depends on the effective integration and management of knowledge (Grant, 1996; Spender, 1996). On the other hand, the information processing view suggests that enhancing performance depends on minimizing internal and external uncertainty by improving information flow (Dollinger, 1984; Galbraith, 1977). Both views seem vital, and their respective problems were solved in the case company by the combination of the ERP and KM initiatives.

The examination of the relationship between ERP and KM also suggested that intra- and interorganizational social processes had been altered and reshaped through the implementation of the two initiatives. This change was evident in the occurrence of intergroup conflicts, resulting from the shift in information ownership. It was found that converting engineering and R&D information into the format necessary for the ERP system had shifted information ownership to the production division. This occurred because there was no system available which could perform a two-way translation between information produced by the engineering and production divisions and between ERP and other systems, such as the product data management (PDM) system. In other words, information produced by the engineering and R&D divisions was made available to the production division through ERP, but not from the production division to others. Reactions of resistance to the loss of information ownership have been observed in other empirical observations of organizational change (e.g., Hutt, Walker, & Frankwick, 1995; Kirkman & Shapiro, 1997; Nadler, 1981). In the case company, the resistance was evident on the part of the engineers in their reluctance to get involved in, and indeed total disengagement from, attempts to encourage their sharing and integration of knowledge. This problem underpins the fact that an unbalanced power distribution between divisions can lead to "breakdowns" of the social process (Brooks, 1994; Pfeffer, 1981) and as a result hamper the flow of knowledge across functions (Brass & Burkardt, 1993).

Moreover, the alteration of interorganizational social processes was evident in the change in the landscape of social networks. Referring to the earlier example, the reduction in the number of suppliers and service providers led to the loss of some valuable "social capital" (Nahapiet & Ghoshal, 1998), which had been developed over time. According to Nahapiet and Ghoshal, social capital is vital for knowledge sharing within and across social networks and critical to the creation of new knowledge. From the above discussion, it is clear that ERP, in contrast with KM, had tended to focus on the task-related process and ignored the soft issues–the social processes. Such an oversight also reflects the current theoretical development of ERP and reflects its narrow focus on organizational efficiency and productivity.

Organizational Efficiency and Flexibility

Moving beyond the trade-off between efficiency and flexibility, Adler et al. (1999), based on an empirical study of Toyota's production system, suggest four mechanisms that can allow a company to be both efficient and flexible: meta-routines, enrichment, switching and partitioning. According to them, meta-routines, defined as "standardized procedures for changing existing routines and for creating new ones" (p. 50), are vital for enhancing the efficiency of nonroutine operations. The concept of enrichment underpins a learning mechanism by which nonroutine tasks are continuously integrated and embedded into standardized activities. Switching refers to the process whereby employees sequentially perform routine and then nonroutine tasks. Finally, partitioning

suggests the creation of organization subgroups that "specialize in routine or in nonroutine tasks" (p. 50).

It is possible to consider how the ERP and KM initiatives in the case company impacted on these mechanisms. In terms of metaroutines, both ERP and KM appeared to promote the enactment of metaroutines. The adoption of ERP had led the company to standardize the activities of information processing and management. More critically, new organizational processes were designed and implemented to maximize the potential of ERP (Taylor, 1998). Similar arguments can be employed to conceptualize the role of KM, since this allowed the company to systematically externalize and codify knowledge for catalyzing innovation (von Krogh et al., 2000).

In terms of enrichment, ERP's design and orientation had tended to inhibit this process. This was because it encouraged the dependence on predefined and preselected routines. The ERP system assumed routine activities and did not take into account the occurrence of nonroutine activities. In other words, ERP was installed to maximize organizational efficiency at the cost of flexibility. However, the KM initiative encouraged new knowledge generated by the learning and innovation communities to be further applied in different tasks. In particular, various pilot teams, based on the learning communities, were formed as pioneers for process and product innovation. This suggests that the KM initiative in the case company is critical, particularly in complementing the limitation of ERP and embedding nonroutine tasks into existing organizational routines.

ERP's strong emphasis on efficiency was further evident in its impact on the phenomenon of switching. Within the production division, for instance, where the impact of ERP was observed, there was a large proportion of standardized activities and very little if any switching was evident. Switching did occur occasionally, in particular through involvement in training and participation in learning and innovation communities. However, the targets of training courses were primarily poor performers. In other words, individuals and units that had achieved the production standard and target were excluded from the activities of switching. So switching in the case company did not encourage anything other than a reinforcement of the standardized activities. In contrast, tasks performed by the consultancy division were highly diverse and nonroutinized, coinciding with other empirical accounts (e.g., Martiny, 1998; Fincham, 1999). Yet, even here was limited evidence of switching was observed. The tasks performed in the consultancy division demanded high levels of flexibility. Efficiency was much less relevant. So individuals in this division were almost exclusively involved in nonroutine tasks and rarely switched to routine tasks. The fact that little switching occurred in either division suggests a contingency account is necessary, with different types of tasks requiring different organizational structures (Burns & Stalker, 1961; Lawrence & Lorsch, 1967). In this sense the ERP system had encouraged partitioning, with different divisions specializing in either routine or nonroutine tasks. So efficiency *and* flexibility were achieved simultaneously by different divisions specializing in one or the other of these processes, rather than each division being involved in both.

[2]In the study, suppliers refer to the providers of tangible goods, such as components and raw materials, while service providers refer to individuals or organizations that provide intangible products, such as consultancy or delivering training courses, to the firm.

CONCLUSION AND IMPLICATIONS

This chapter has explored the simultaneous implementation of two contemporary managerial systems, ERP and KM, and their combined influence on organizational efficiency and flexibility. The discussion of similarities and differences has revealed that the two systems are critical for revitalizing organizations. Thus, while ERP emphasizes the improvement of information processing efficiency, KM can facilitate the simultaneous development of an organizational knowledge exploration and exploitation capability. Their differences and similarities were further examined and evaluated through considering their impacts on intra- and interorganizational processes. The analysis of the content, context and process of ERP and KM has suggested that the two systems can provide complementary outcomes. However, such a synergetic outcome can only be created and developed when the design of task-related processes fits into the metaroutines imposed by ERP and KM, and the social processes are nurtured within functions and cross-functionally. Particularly, nurturing such social processes will largely depend on how information and knowledge ownership can be differentiated and how the landscape of the social network can be reshaped.

In addition to the theoretical contribution, this study has identified and explored some issues that are vital for practitioners to take into account. For organizations planning to adopt and implement ERP and KM, it is critical to consider the different orientations and foci associated with each initiative. More importantly, it would be judicious to evaluate and prioritize the corelation between organizational efficiency and flexibility that will fit the design and long-term development of the organization. Again, the significance of social capital and social networks should not be underestimated.

In relation to the growing need for organizational revitalization and transformation, future research could usefully place emphasis a broadening of our understanding of how different initiatives can be integrated and how different approaches to integrating these initiatives can maximize their potential and leverage competitiveness. Furthermore, further research should also critically evaluate how different organizational initiatives can be prioritized to avoid potential innovation overload.

ENDNOTES

1. Names of the case company and consulting firm have been disguised.
2. In the study, suppliers refer to the providers of tangible goods, such as components and raw materials, while service providers refer to individuals or organizations that provide intangible products, such as consultancy or delivering training courses, to the firm.

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Chapter VII: Knowledge Management for Enterprise Systems–First Empirical Insights

OVERVIEW

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Enterprise systems are comprehensive and complex applications that form the core business operating system for many companies worldwide and throughout most industries. The selection, implementation, use and continuous change and evolution of enterprise systems (ES) require a great amount of knowledge and experience. Empirical studies show that the management of knowledge is one of the main cost drivers of Enterprise Systems projects. Consequently, organizations have realized the need to better leverage their knowledge management for Enterprise Systems. This chapter proposes a framework for structuring knowledge for Enterprise Systems. This three-dimensional framework is derived from meta-case studies and comprehensive literature analysis. It consists of dimensions for the ES life cycle, the Knowledge Management life cycle and the types of knowledge. Preliminary empirical insights show that especially the lack of soft knowledge is a critical success factor that leads to significant consulting costs in ES projects.

THE SIGNIFICANCE OF KNOWLEDGE MANAGEMENT FOR ENTERPRISE SYSTEMS

Enterprise systems (ES)–synonyms are enterprise resource planning (ERP), enterprise-wide systems and enterprise application systems–can be defined as customizable, standard application software which includes integrated business solutions for the core processes (e.g., production planning and control, warehouse management) and the main administrative functions (e.g., accounting, human resource management) of an enterprise (Rosemann, 1999). In order to configure and use ES efficiently, components such as implementation tools (procedural models, reference information models, customizing guidelines, project management software), work-flow functionality, tools for the development of add-on modules and system administration, and office suites are usually embedded with the ES software.

Implementing comprehensive IT applications like Enterprise Systems is a knowledge-intensive task. As such, it requires a great amount of experience from a wide range of experts such as representatives from business departments, technical specialists from the IT department and project managers within the organization up to external business and implementation consultants.

"On one hand organizations want to reduce the engagement of costly consultants, but on the other hand hardly any organization has the internal knowledge and skills to implement an ERP system successfully without external help. Choosing the right consultants and using their skills and knowledge appropriately, as well as transferring

and retaining essential knowledge within the organization becomes essential to the overall success of an ERP system implementation."(Haines & Goodhue, 2000).

Organizations implementing Enterprise Systems recognize this and find that managing knowledge directly deals with the most significant costs of an ES project. Thus, there is strong motivation for better leveraging ES implementation knowledge and making this knowledge available to those involved in the ongoing management of the system.

This chapter proposes a three-dimensional framework in order to structure the knowledge which is required to manage an Enterprise System. This framework was derived from comprehensive literature reviews and analysis. This chapter also discusses pilot results of an empirical survey, which has been conducted in order to verify the framework. The results explicate what managers regard as important issues in the area of Enterprise Systems. While most existing ES literature has focused on the methodologies and critical success factors required for the implementation of ES software (Rosemann & Chan, 2000), it is noticed that they have not taken aspects of Knowledge Management into account. This chapter will start in the next section with a discussion of the possible interrelations between Knowledge Management and Enterprise Systems. The focus will be characterized as "Knowledge Management for Enterprise Systems." A framework and its three dimensions–knowledge lifecycle, ES lifecycle, and types of knowledge–will be presented. A preliminary empirical study has been conducted in order to test the structure and completeness of this framework. The initial outcomes will be explained for all three dimensions. The chapter ends with a brief summary and an outlook.

KNOWLEDGE MANAGEMENT AND ENTERPRISE SYSTEMS

The interrelation between Knowledge Management and Enterprise Systems has two facets.

- On the one side, implemented Enterprise Systems can serve as a main source for Knowledge Management. As Enterprise Systems support various areas of a company such as procurement, manufacturing, ware- housing, sales, distribution, and accounting, an analysis of the run-time data (transactions, involved organizational units) can provide the knowledge manager cost-effectively with useful data about the current process performance. This perspective characterizes Enterprise Systems as a knowledge repository and can be described as "*Enterprise Systems for Knowledge Management*."
- On the other side, the management and especially the implementation of an ES solution requires a substantial amount of specific knowledge and expertise. Thus, a separate ES-related Knowledge Management can be identified that covers the entire management of knowledge in an ES project. This perspective can be characterized as "*Knowledge Management for Enterprise Systems*." This is the focus of the research presented in this chapter.

The demand for ES-related knowledge and support resources is high and the lack of expertise has resulted in the turnover and poaching of ES- knowledgeable staff (Gable, Heever, Erlank, & Scott, 1997). The loss of employees with ES-specific knowledge often hurts an organization in poorly equipped post-implementation phases. Without a proper framework and a model for managing the knowledge through all the phases of the ES

lifecycle, managers may not be able to successfully tide their system over for the future maintenance and upgrade phases of an ES system. The case studies espoused (Rosemann & Chan, 2000) describe this need for the cohesion and organization of this flux of different kinds of knowledge as of critical influence. The framework derived from these case studies will be explained in the next section.

Framework for ES-Related Knowledge Management

Dimensions of This Framework

In order to structure the knowledge which is required for the management of Enterprise Systems, a three-dimensional framework is proposed (Rosemann & Chan, 2000). This framework has been derived from a comprehensive literature analysis. Knowledge required in an ES project can be classified along these three dimensions:

- The stages of the *knowledge lifecycle*: identification, creation, transfer, storage, (re-)use and unlearning of knowledge.
- The phases of the *Enterprise System lifecycle*: selecting, implementing, using, and changing the ES.
- The *types of knowledge* required (the knowledge content): business, technical, product, company-specific, project management, and communication/coordination/cooperation knowledge. Figure 1 shows the design of this framework with the three dimensions.

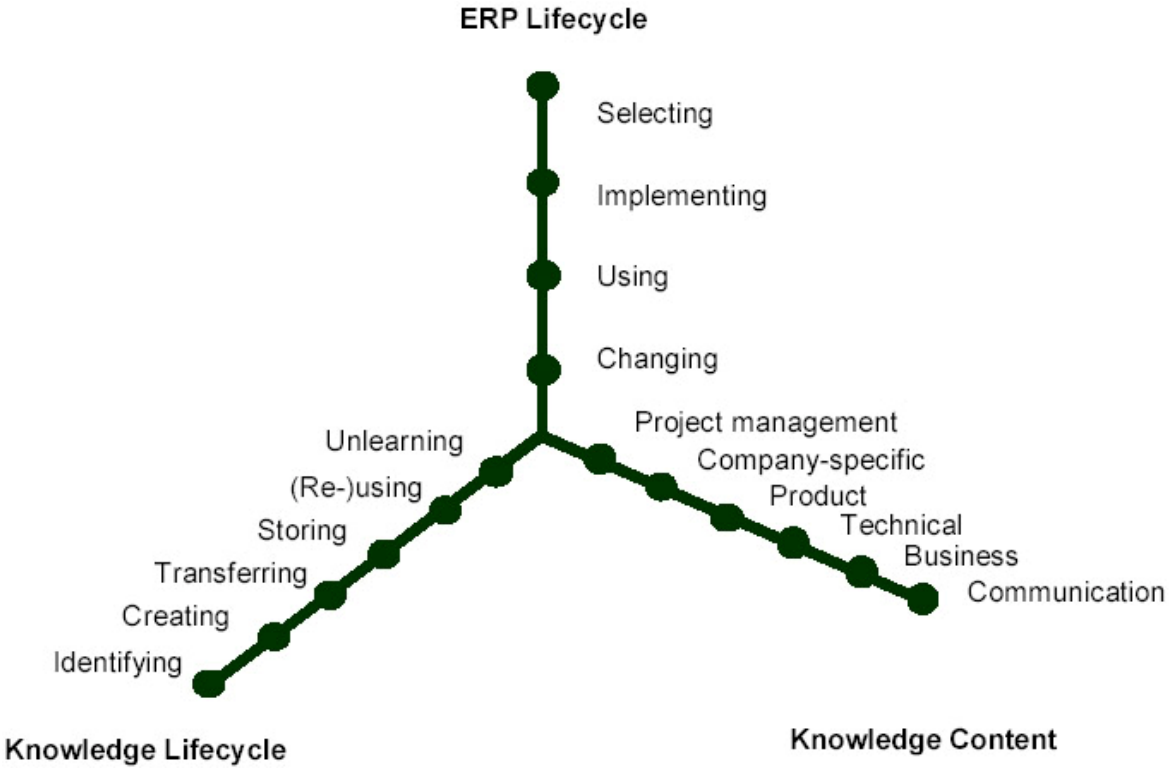

Figure 1: A framework to structure ES-related knowledge

The proposed framework serves as a starting point to analyze and structure required knowledge in an ES project. The activities in the knowledge lifecycle should be viewed as a coherent single unit. One activity inadvertently affects another and the attributes in each dimension are also related to one another. They impact the (know-what) declarative knowledge, i.e., meta-knowledge, (know-how) procedural knowledge and (know-why) usual knowledge (Zack, 1999a, 1999b, 1999c) in the organization.

The flow of the knowledge in this framework requires tight coupling from one attribute to another. Each attribute indirectly/directly influences another. The three dimensions must be embraced as a holistic approach to the entire ES management and not be treated separately. This framework is by no means a comprehensive and final one. Changes may be made to the implementation process when it is midway through the installation process. However, any changes to the implementation plan will mean that the factors from the knowledge lifecycle attributes have to be reviewed and catered for. On a conceptual level, this framework can be used for the specification of a knowledge repository. The three dimensions of this framework are discussed in further detail in the following paragraphs.

Enterprise Systems Life Cycle

The ES lifecycle stresses the specific focus of this knowledge framework. Only few publications discuss ES beyond the cost-intensive system implementation phase. The following list gives an overview about some ES lifecycle models.

- Bancroft (1996) proposes an ES lifecycle with a concentration on the early stages that includes focus, as is, to be, constructing and testing and actual implementation.
- Gable et al. (1997) suggest a lifecycle that consists of consulting process, selecting the ES software, implementing the software and learning and knowledge transfer.
- Markus and Tanis (2000) differentiate along the ES lifecycle between chartering, project, shakedown and onward and upward.
- Ross and Vitale (2000) differentiate in an analysis on the perceived organizational performance into design, implementation, stabilization, continuous improvement and transformation.
- As one suggestion for a consolidation of some of these models, Shanks et al. (2000) propose to distinguish between planning, implementing, stabilization and improvement.
- An example for a software-specific approach is *ValueSAP* (SAP, 2000), a framework of methodologies, tools, knowledge, and programs. ValueSAP aims to increase the value out of SAP's ES solution during the entire life cycle consisting of the three phases discovery and evaluation, implementation and operations and continuous improvement.

All these approaches have an implementation stage in common. They are similarly elaborated with regards to pre- and post-implementation stages. However, most of them lack a definitive phase for the *use* of the system. This is noteworthy as it is actually the longest phase of the ES lifecycle. The use of an Enterprise Systems is the area in which the organization is supposed to benefit the most out of their ES system.

"The value of an ES lies not so much in the product itself, but in its effective and efficient usage" (Kremers and van Dissel, 2000). Therefore, the lifecycle of an Enterprise System in the framework covers the selection, the implementation, the use and the continuous change of this software.

The *selection* stage includes the definition of the company's requirements, a first market overview, a preselection of ES solutions, a request for proposals, detailed system evaluation, economic evaluation and final ES selection. The *implementation* consists of the configuration of the ES software and the introduction of corresponding organizational and technical changes like the definition of new responsibilities or the design of new interfaces (Keller & Teufel, 1998; Kirchmer, 2000). In relation to the entire life span of Enterprise Systems software, the implementation phase is rather short. Nevertheless, it still usually consumes most of the budget. In order to execute the ES processes the staff member needs a precise understanding of the software and related business knowledge. Detailed information about the ES configuration is not necessarily required. In contrast to the implementation, explicit knowledge is more widely available during the use of an ES.
Furthermore, the involved knowledge owners are mostly internal. This knowledge in the implementation stage is often shared by staff members who *use* the Enterprise System. The transfer of knowledge and project-specific knowledge becomes less important. Typically, an Enterprise System has to be continuously *changed* as it usually reflects a major part of the organization's businesses. Therefore, with every new market, product, location, etc. introduced by the organization or external changes like the introduction of a new currency (e.g., Euro), an ES- related change management requires knowledge about the influence of these changes on the Enterprise System and the opportunities of the Enterprise System to depict these changes. Moreover, continuous upgrades of the Enterprise System demand an ongoing upgrade process with a permanent evaluation of modified and new system functionality.

Knowledge Life Cycle

The emphasis of Knowledge Management is on managing an organization's knowledge resources as the key to the organization's growth. While the definition of Knowledge Management remains pervasive, much literature has been written in the field of Knowledge Management. This chapter will not cover the various aspects of Knowledge Management, but will view it through the lens of a knowledge lifecycle and focus on activities that are carried out to enable knowledge creation and process innovation.

The core of Knowledge Management activities is the organization of processes in which new knowledge is developed, distributed to those that need it ("knowledge workers," Drucker, 1989) and made accessible for the future use and reuse within the entire organization. Knowledge creation and process innovation focus on the competence of organizations, namely, the capacity to interpret data and assign it a value.

It is useful to note the process of unlearning (McGill & Slocum, 1993), whereby the organization lays aside its old knowledge by considering it as obsolete. Drucker (1989) suggests that one of the most important challenges for every organization in the knowledge society is to build systematic practices for self-transformation. The organization has to be prepared to *abandon* knowledge that has become obsolete and learn new things. Unlearning can be differentiated into explicit and tacit unlearning. Explicit unlearning includes a controlled process of deleting explicit knowledge (like user documentation of an old ES version). Tacit unlearning takes the form of "learning to

forget," i.e., disremember old techniques and ways of doing tasks in preference of new methods.

Based on the literature reviewed on Knowledge Management (Rosemann & Chan, 2000), the consolidation of this research has derived a knowledge lifecycle depicted as shown in Figure 2. This knowledge lifecycle is depicted in a simplified way, as it suggests a strict sequence of identifying ☐ creating ☐ transferring ☐☐storing ☐ (re-)using ☐ unlearning knowledge. However and obviously, further links between these different tasks exist, which are not depicted due to the complexity in the cardinality of the relationships. The following diagram shows a basal set of activities that are associated with Knowledge Management.

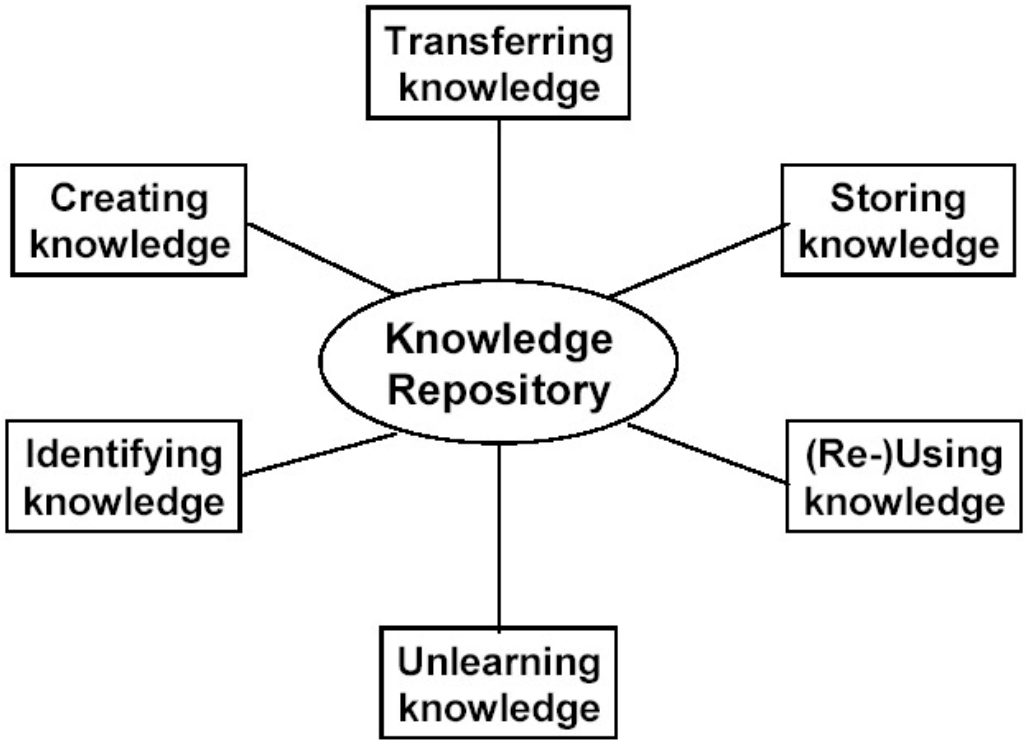

Figure 2: The proposed knowledge life cycle

Types of Knowledge

Managing an Enterprise System requires a wide range of knowledge. In order to develop a list of the required areas of knowledge for ES management, an intensive literature review was conducted. This review included case studies and papers discussing the critical success factors for the ES implementation (Rosemann & Chan, 2000). It also took into account the importance of skills as perceived by IS specialists in a recent study (Martinsons & Cheung, 2001). The areas of knowledge that are mentioned are similar and the repetition of the need for this knowledge from the case studies emphasizes the need for knowledge to be made explicit. Thus, it is necessary to organize these areas of knowledge into a more manageable form. From the meta-case studies of the literature reviewed, six different types of knowledge are clearly identified and distilled for the successful management of ES software. These types of knowledge to be taken in mind are: business knowledge, technical knowledge, product management knowledge, company-specific knowledge, project knowledge, and communication, coordination, and cooperation knowledge.

Figure 3 shows these identified types of knowledge required for managing Enterprise Systems.

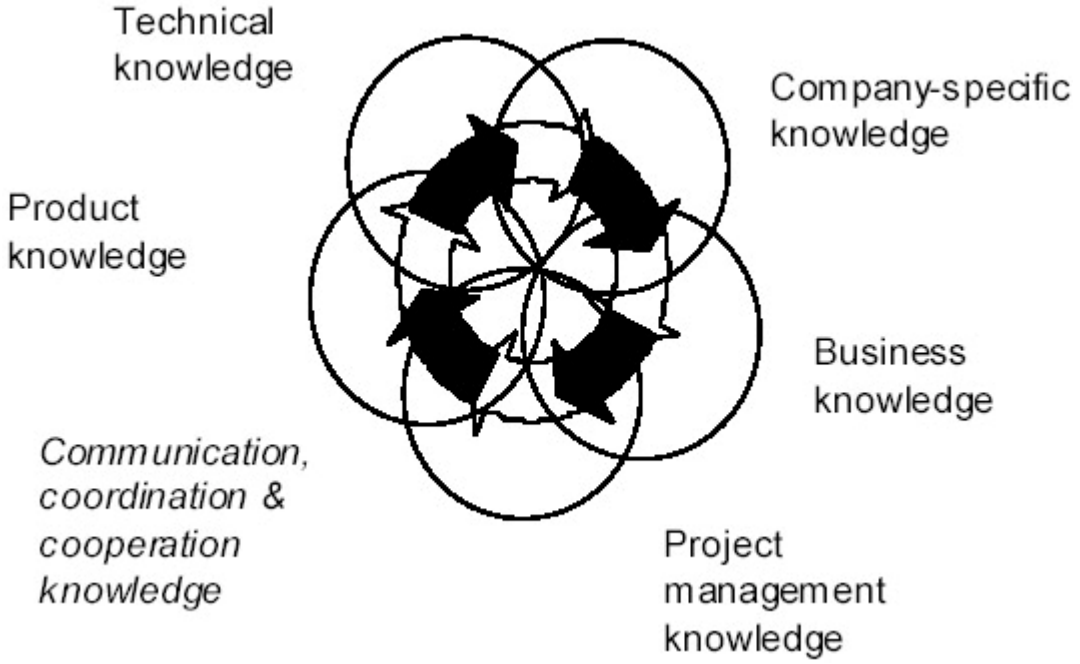

Figure 3: Identified knowledge types for ES management

Business knowledge covers the business issues in the management of Enterprise Systems. Most of the attributes of this dimension should be addressed before the actual implementation of ES in an organization. Business knowledge includes:

- functional knowledge in areas such as general ledger accounting, purchasing, sales, human resource management, or strategic planning;
- organizational knowledge such as business process management, communication policies, or document management;
- educational knowledge; and
- knowledge about enterprise culture.

Technical knowledge represents knowledge that is necessary in conjunction with the selection and use of database management software, network management, add-on programming, client-server architectures, performance measurement, etc.

Product knowledge reflects the need for knowledge specific for a unique ES solution. Most ES solutions are comprehensive packages with a high degree of complexity. Consequently, Enterprise Systems became an area with an enormous importance of product-specific knowledge. This area of knowledge includes, among others, the understanding of the architecture of the product, knowledge about its functionality and existing constraints, the implementation methodology, the release strategy or knowledge about the ES-specific programming language (like SAP's ABAP). Thus, this area of knowledge combines from a product-individual point-of-view business, technical and project- management knowledge.

ES software is selected, implemented, used and changed in a specific company with individual characteristics and an individual organizational population. The knowledge type *company-specific knowledge* takes this into account. ES cannot be managed successfully without having a precise understanding of these company individual factors. This is the reason why the participation of the end users is a critical success factor for ES implementation projects and ES never can be completely outsourced. This type of knowledge is also related to specific business and technical knowledge.
Project management knowledge covers the management of human resources, time and cost to accomplish the objectives of a project. The implementation of an Enterprise System often requires project management for a time between 6 to 24 months. Project management involves planning, organizing and controlling a project with various time and cost constraints and gathering senior management support. It also seeks to achieve outputs such as milestone definition and objectives (Weiss & Wysocki, 1992).

Usually different project participants have the five types of the required ES knowledge. Consequently*, communication, coordination and cooperation knowledge* is required in order to integrate the five types of knowledge. It is obvious that even if the five types of knowledge (business, technical, product, company, project) are available in a project, the missing capability to efficiently interact between the involved knowledge owners might cause a project failure. Usually, it takes a significant amount of time to develop the required communication, coordination and cooperation knowledge or to get the knowledge from different project members.

In order to evaluate the completeness and relevance of this framework a preliminary empirical study has been conducted. The design and first results of this survey will be discussed in the next section.

EMPIRICAL RESULTS

Research Questions and Design

The proposed framework was derived from a comprehensive literature analysis. It was also modified and extended by feedback received at conferences and includes personal experiences in the area of managing Enterprise Systems. In order to test this framework, an empirical study has been conducted. This study had the following objectives:

- Validation of every single dimension of the framework: Are the attributes of every dimension complete? Are they redundant? Are certain aspects not relevant?
- Validation of the overall framework: Are the dimensions independent from each other? Is any dimension missing?
- Evaluation of the importance of the different dimensions and their characteristics.

The designed survey instrument consisted of eight pages and was structured in correspondence with the proposed framework. Standard personal data and demographic information were collated. Information regarding the required knowledge types and the ES lifecycle phases in which the Enterprise System is used was collected. The respondents were asked to answer questions related to each dimension. The levels

of importance were classified into five degrees with each rating given a weight of 1 for "Unimportant" and 5 for "Most Important." Final questions referred to the acceptance of the overall framework as well as the identification of critical success factors with regards to Knowledge Management for Enterprise Systems. The survey was first piloted with colleagues at an Australian university. The participants were contacted via e-mail list servers. The survey was available on the Internet to foster faster receipt of survey results as well as to extend the survey widely across various organizations.

Preliminary Results

The following preliminary empirical results are based on the feedback of the first 10 participants of the questionnaire. While the sample size is small, the quality of the participants' results from the open-ended questions has demonstrated that the participants have adequate knowledge about the related research area to answer the questions. It is also noted that the pilot study is an exploratory and descriptive one.

The participants came prominently from managerial and executive backgrounds. Five participants were in the phase of using an Enterprise System, three have not selected an Enterprise System yet and the remaining were in the process of changing and implementing their ES. The participants were asked in the initial part of the survey about the importance of each activity in the knowledge lifecycle in regards to managing knowledge in their organizations. They were also asked to express their opinions on other activities that they felt were required to manage knowledge and if they had used any tools to manage knowledge. The second part of the survey required the participants to rate the importance of managing knowledge in each phase of the ES lifecycle. Then, the participants were asked to rate the importance of each type of knowledge required for an ES. Open questions towards the end of the survey allowed participants to evaluate the completeness of the proposed framework and to identify critical success factors with regards to Knowledge Management for Enterprise Systems.

From the received feedback, this chapter concentrates on the development of "levels of importance." The figures for each dimension of the framework show the importance of each characteristic perceived by the respondents. The diagrams can be interpreted in the subsequent manner: Mean, maximum and minimum scores for the results are firstly tabulated and then plotted on a Web graph. The greater the tendency for the line to extend from the inner concentricity of the graph, the higher is the importance of the factor perceived by the respondents.

Knowledge Life Cycle

The results of the survey indicate that the participants feel that the activities required for creating new knowledge and transferring knowledge score relatively high on the importance scale (see Figure 4). It is interesting to note that the activities in the knowledge lifecycle are consistent with a median score of more than 3 but fall steeply into the phase of unlearning knowledge. The possible explanation for this phenomenon could be the traditional practice and social norm that individuals are unwilling to unlearn old ways of performing tasks. Also, there is little research in the area of unlearning. It might also be explained by the participants' limited experiences with Enterprise Systems.

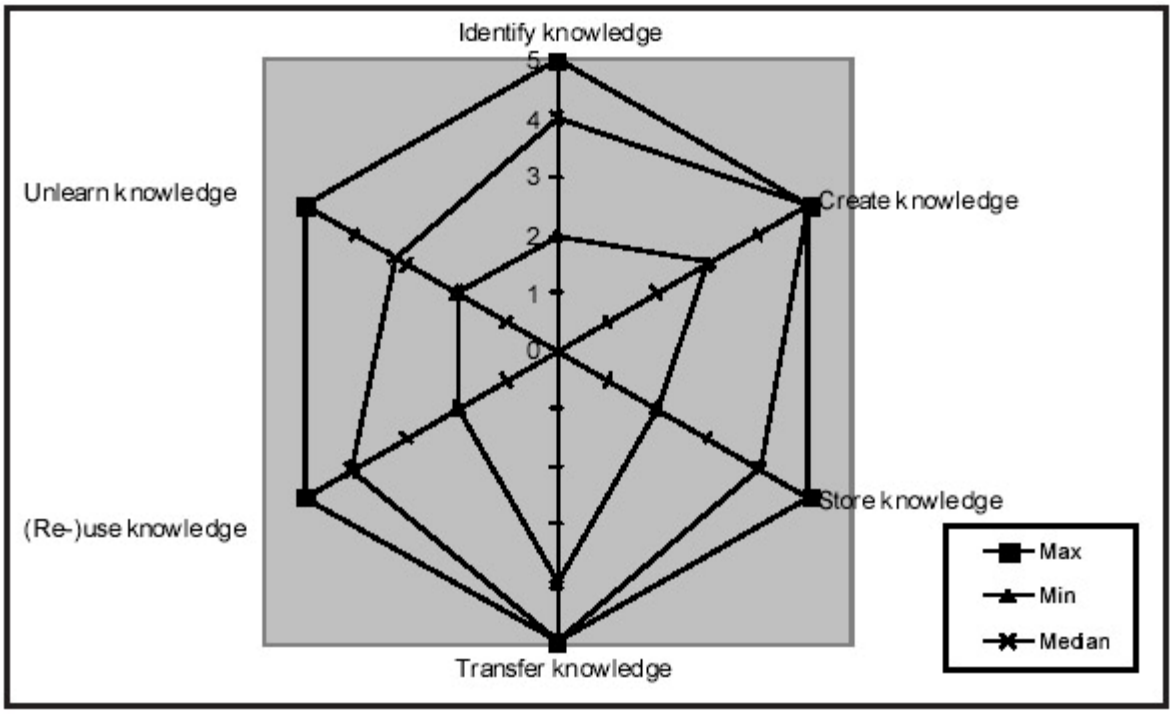

Figure 4: Importance of activities throughout the knowledge life cycle

However and most obviously is the fact that the "value-adding" activities of creating and transferring knowledge are the most important activities in the knowledge lifecycle. "*Knowledge transfer involves two actions: transmission (sending or presenting knowledge to a potential recipient) and absorption by that individual or group ... The goal of knowledge transfer is to improve an organization's ability to do things, and therefore increase its value"* (Davenport, 1998). Organizations clearly put emphasis on value- adding activities such as creating new knowledge and transferring knowledge, which leads to process innovation.

Enterprise Systems Life Cycle

Figure 5 shows the results of what participants of the survey evaluated as the important phases during the ES lifecycle. These phases require special attention regarding the management of knowledge as different types of knowledge are required during different phases. The preliminary results (in correspondence with Figure 6) indicate that the implementation stage is the by far most critical phase of the lifecycle regarding Knowledge Management. The reasons for this might be that:

- The implementation stage is usually a unique and new experience.
- The responsible project team usually never worked together before.
- The implementation might be the only stage that the participants experienced.
- The implementation is the phase that has the greatest impact on the benefits and costs of the Enterprise System.
- The implementation of ES usually required the involvement of external experts.

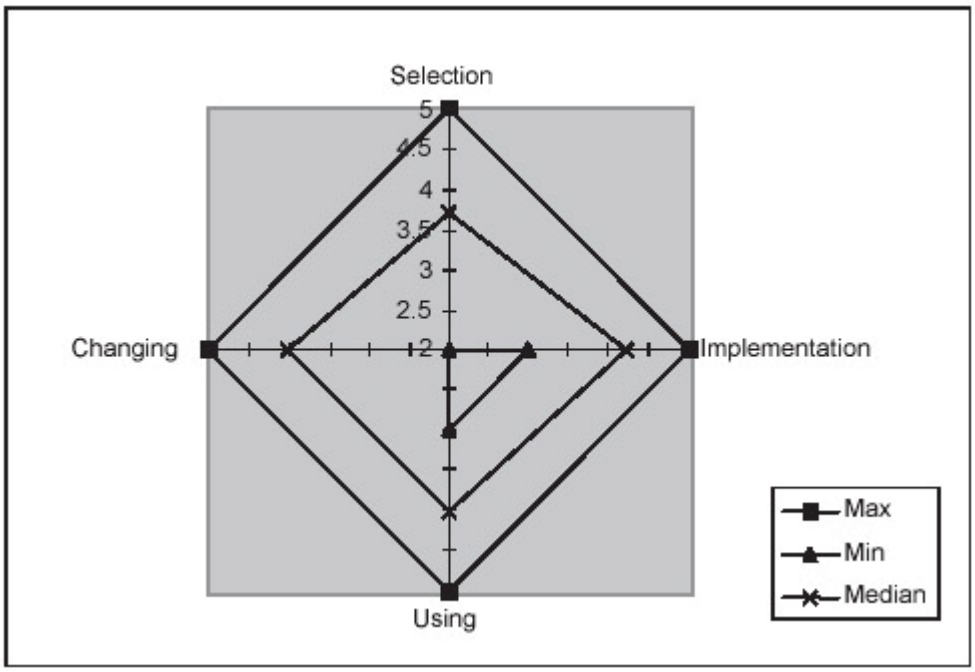

Figure 5: Importance of knowledge management in the stages of the ES life cycle

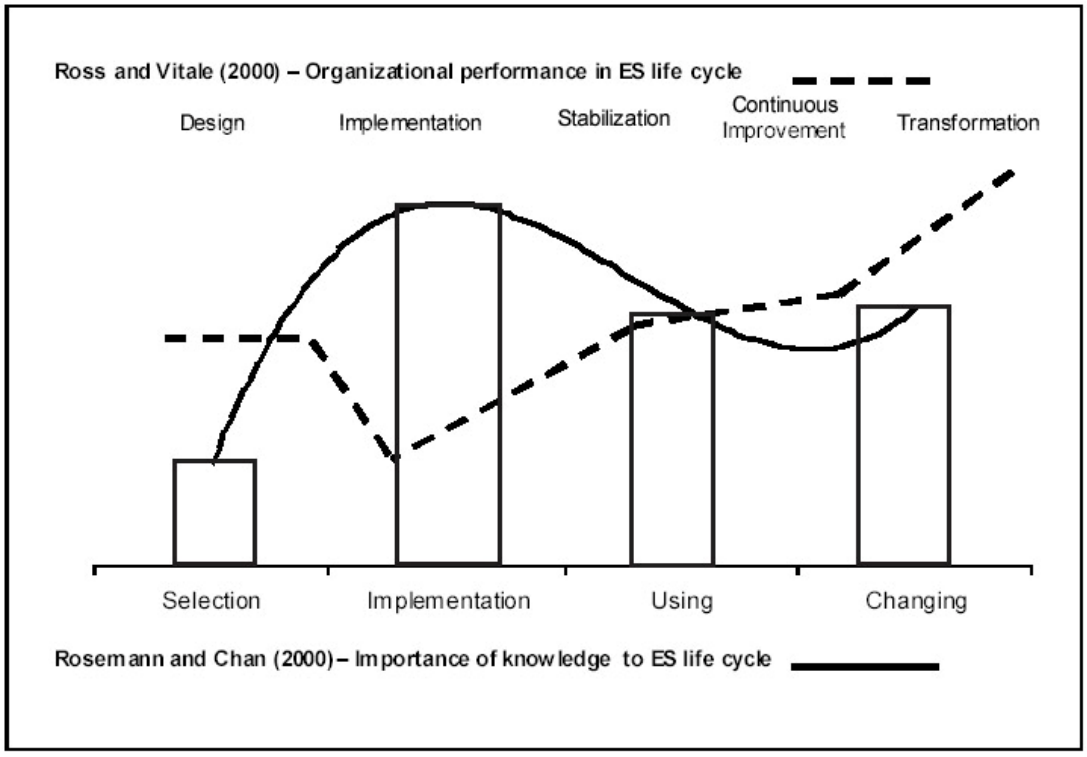

Figure 6: Organizational performance vs. importance of knowledge

Knowledge is seen as crucial to an organization during the implementation phase as it is usually "new" and unavailable to employees of the organization. Organizations also realize that they rely heavily on external knowledge (consultants). They seek to retain this knowledge within their organization for future use and change of the ES. The results of this study correspond with the intensity in which supporting tools for the

different ES lifecycle phases are developed. While the implementation is supported by various tools, the selection, use and especially the system change support is rather weak. Kremers and van Dissel (2000) refer the change of an ES to "migration" and explains that "*migration has a bad reputation with the users of ES systems … such projects are time- consuming and expensive*". Thus, ES vendors may be motivated to offer smoother ES change paths and better support tools for their customers.

Ross and Vitale (2000) examined in their study how firms are generating value from the implementation of ES. The findings showed that organizations experience a "dive" during implementation. This "dive" in organizational performance is largely due to the change in business processes, the effort to realize the changes, organizational culture and, consequently, the lack of knowledge about ES implementation issues. Figure 6 compares Ross and Vitale's representation of the organization performance along the ES lifecycle and the proposed ES lifecycle. The results show that the respondents recognize a specific need for knowledge to be captured during implementation. This phenomenon is reflected in the study of Ross and Vitale as the respondents perceive a "dive" in the organizational performance. Between the stages of implementation and stabilization, the perceived importance for knowledge increases. This view is consistent in continuous improvement and transformation.

Types of Knowledge

One of the most interesting outcomes of this current research work and future study is the perceived importance of the six different types of knowledge. The preliminary results (Figure 7) highlight the importance of "soft" knowledge such as communication/coordination/cooperation knowledge and also project management knowledge. Furthermore, the context-sensitive company-specific knowledge is ranked highly. It is interesting to note that the product-specific knowledge (e.g., SAP skills), which is often perceived as a bottleneck in ES projects, is ranked together with technical skills as the lowest.

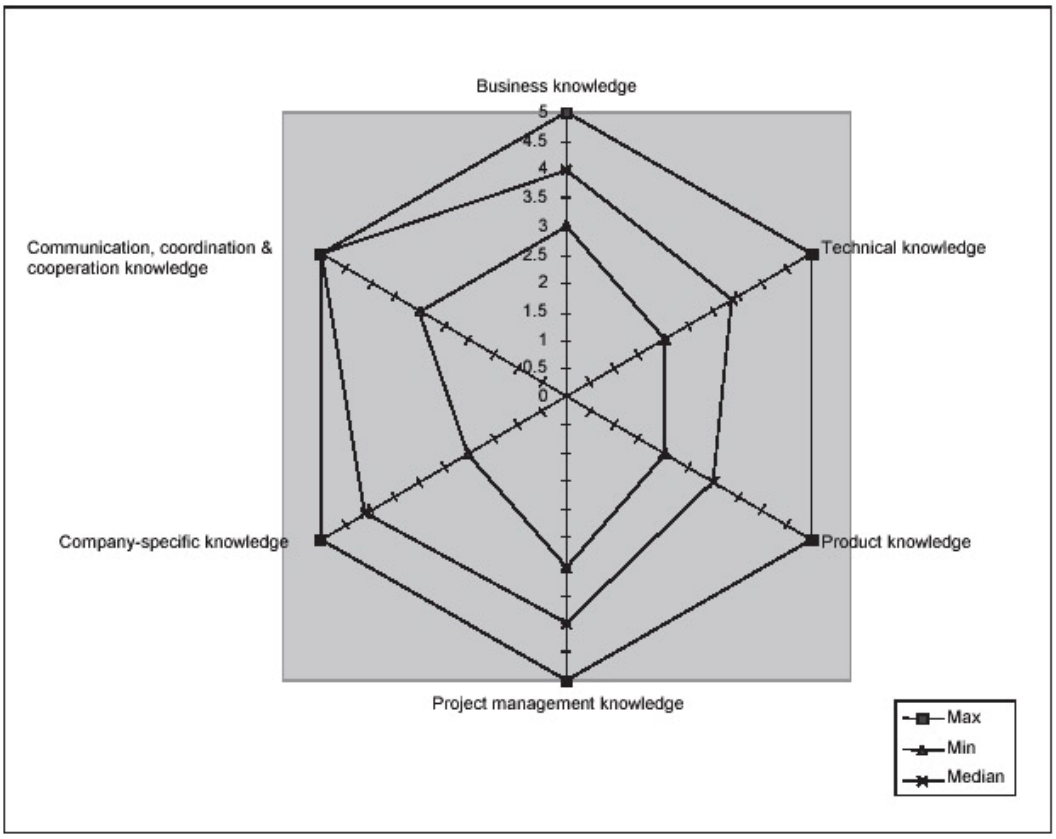

Figure 7: Importance of different types of knowledge

SUMMARY AND OUTLOOK

This chapter proposed a three-dimensional framework for the management of knowledge in Enterprise Systems. The discussion of each dimension of this framework was followed by preliminary empirical results that seek to validate the framework and also to develop an awareness for the more important attributes of the framework in regards to the need for Knowledge Management. The preliminary results have demonstrated some initial insights such as the importance of value-adding activities and "soft" knowledge types.

Based on more comprehensive feedback, the research aims to develop individual levels of importance for each of the four phases of the Enterprise Systems lifecycle. The assumption is that these results will show how the perceived importance of different Knowledge Management activities and knowledge types changes along the ES lifecycle. The eventual objective will be to synthesize more detailed results specific to each dimension and to finally integrate all three dimensions of the framework.

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Chapter VIII: Implementation Management of an E-Commerce-Enabled Enterprise Information System: A Case Study at Texas Instruments

OVERVIEW

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This chapter presents a case study of an overview of the efforts of Texas Instrument's (TI's) internal and external ERP implementation, with a focus on linking its ERP system in a global e-commerce setting. This linkage is especially important since it had been stated in TI's strategic plan as an objective of this project to provide visibility of the ERP system to external constituents via Web linkages along with the objective of standardizing internal processes and important information technology systems to support market needs. Thus, its ERP system is central to managing its supply chain and B2B e-commerce linkages from both a customer and supplier perspective. Issues faced by TI are clearly outlined with future questions also posed in the final section.

INTRODUCTION

The integration of enterprise systems and the supply chain to an organization is becoming more critical in an ever-changing, globally competitive environment. As markets mature and customer preferences become more diverse and specific, quick response to those needs is required to maintain competitive advantage. This quick response will require close relationships, especially communications and information sharing among integrated internal functional groups, as well as the suppliers and customers of an organization. Texas Instruments (TI), headquartered in Dallas, Texas, is one organization that has come to realize this requirement for building and maintaining its competitive edge. One strategic decision made by the organization was to implement an enterprise resource planning (ERP) system with a focus on linking it with a global electronic commerce (e-commerce) setting.

This case study provides an overview of the efforts of TI's internal and external ERP implementation that led to over 70% of the transactions being conducted in a global e-commerce setting. TI's strategic goals include providing visibility of the ERP system to external constituents via Web linkages and standardizing internal processes and information technology to support market need. The e-commerce linkage is especially important in achieving these goals. Thus, TI's ERP system is central to managing its supply chain and Web e- commerce linkages from both a customer and supplier perspective.

In this situation there were a number of major players, including project management direction from Andersen Consulting Services, software vendors such as SAP and i2 Technologies, hardware vendors such as Sun Microsystems, and various suppliers and customers of TI. Part of the process involved outsourcing some of TI's internal information systems capabilities to these vendors, especially Andersen Consulting.

The various stages of implementation from adoption to preparation and operation are detailed as separate sections. At each stage of the implementation TI used performance metrics to manage the process. We also provide an overview of how these performance metrics played a role in the implementation.

STRATEGIC SYSTEMS IMPLEMENTATION BACKGROUND

Much research has been undertaken to develop a better understanding of IT implementation and to assess its contribution to improving organizational efficiency. A meta-analysis of IT implementation research (Lai & Mahapatra, 1997) indicates that there is shift in emphasis from studying individual IT to organizational and interorganizational systems. Since an ERP system has long-term and broad organizational implications, strategic planning is key to the successful management of such systems. There is an extensive body of literature related to strategic planning. Critical antecedents to developing a successful strategic plan are (Lederer & Salmela, 1996; Lederer & Sethi, 1992):

1. external and internal environments,
2. planning resources and processes, and
3. an information plan that actually gets implemented.

These constructs provide a theory of strategic information systems planning and are important to both researchers and practitioners involved with planning.

By borrowing from the literature on the management of advanced manufacturing technologies (Meredith, 1987; Sarkis & Lin, 1994; Small & Yasin, 1997), a process-oriented framework for ERP management is presented (see Figure 1). As indicated in the figure, the process suggested by this framework is iterative, in the sense that it allows for higher-level strategies and processes to be reformulated when they are discovered to be incompatible with lower-level systems and configurations and vice versa.

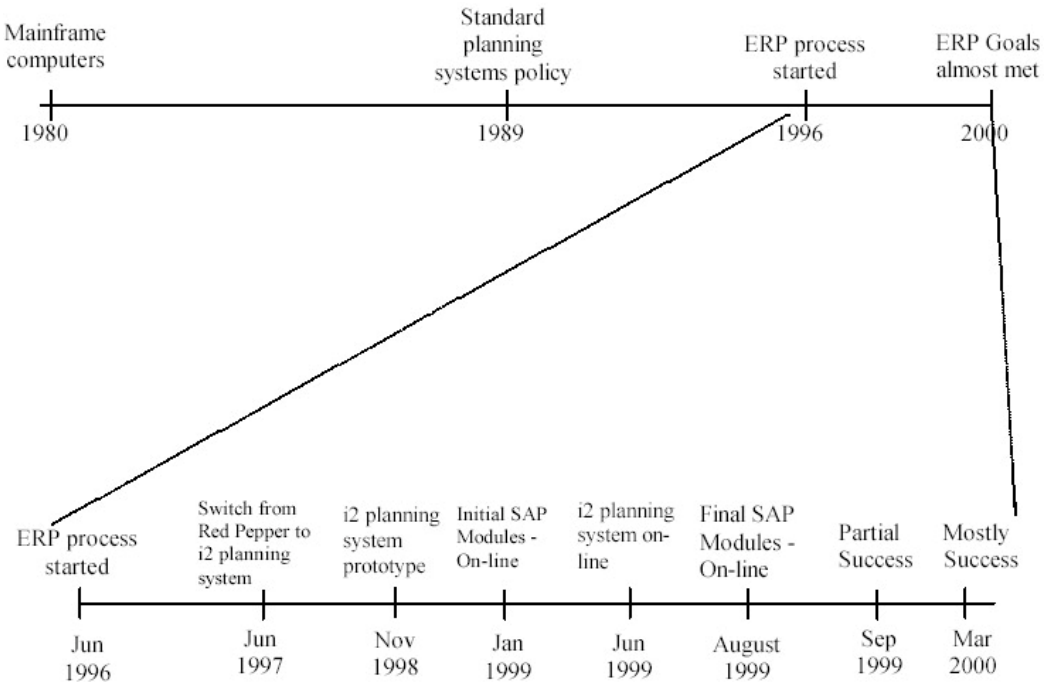

Figure 1: Time line of TI's ERP implementation

Strategy Formulation and Integration

Strategic justification frameworks should begin at the upper levels of management. The technology selected should fit within the vision, goals and strategic objectives of the organization. An organization should undergo a SWOTMOSP process in which it assesses its strengths and weaknesses in the light of environmental opportunities and threats, then develops its missions, objectives, strategies and policies. One of the results of this step in the process is determination of an organization's core competencies that need specific technology support.

Process Planning and Systems Design

At the next level is the initiation of process plans that support the organizational competencies identified earlier and that in turn get supported by the chosen system (ERP or otherwise). Also known as the reengineering phase, three studies are usually undertaken at this stage, and they are named as-is, should-be and to-be.

The AS-IS study provides baseline measures for later justification purposes and provides measures for post-implementation auditing. The should-be study tries to exhibit how the current system should function after nonautomation/non-hard technology improvements (e.g., total quality management) are instituted; a currently disordered system will lead to a disordered ERP system as well. The to be study is used to define the system necessary to meet the objectives set forth by the strategic units.

System Evaluation and Justification

Here, analysis focuses on the economic, technical, and operational feasibility and justification of the system. The justification step should consider many different types of factors–tangible, intangible, financial, quantitative, and qualitative. Since the analysis of

tangible factors (e.g., financial) is well-studied using methods such as return on investment (ROI), our focus will be on the evaluation of intangible factors.

System Configuration

An ERP system has some of the characteristics of packaged software, such as Microsoft Excel, and some of those of custom-built ones. It certainly is not designed and programmed for the exclusive use of one organization nor is its implementation and management as easy as that of packaged software. Each ERP software company is likely to have its own business model in the design of its package. As a packaged software system, there are likely to be discrepancies (at the detailed level) between the needs of an organization and the features of the software (Lucas, Walton, & Ginzburg, 1988). Hence, a significant amount of effort can be expected to configure the system or the organizational processes in order to produce an alignment between them.

System Implementation

The implementation stage can be classified into: start-up, project management and a migration handling the switchover from the old to the new system. ERP systems force large-scale overhaul of business processes and, therefore, their implementation needs to be supported by appropriate change management approaches (Markus & Benjamin, 1996). Another key concern of implementation is that of systems integration, in which multiple types of subsystems, platforms and interfaces must be integrated over diverse and dispersed geographic locations. Systems implementation involves:

- Acquisition and Procurement–Actual purchase of software, hardware and supporting equipment, and personnel.
- Operational Planning–The project plan necessary to bring up the system.
- Implementation and Installation–This is the actual implementation and startup step.
- Integration–Linking the systems to each other and other organizational systems.

Post-Implementation Audit

This last "feedback" stage, although very important from a continuous improvement perspective, is one of the more neglected steps. According to Gulliver (1987), for example, auditing should:

- encourage realistic preparation of investment proposals;
- help improve the evaluation of future projects as well as the performance of current projects that are not proceeding as planned; and
- call attention to projects that should be discontinued.

As can be seen, the process suggested above can be arduous, but this necessary effort must be anticipated for the successful integration of complex and strategic systems into an organization.

IMPLEMENTING A GLOBAL ERP SYSTEM AT TI

Company Background

Texas Instruments Incorporated (TI) is a global semiconductor company and the world's leading designer and supplier of digital signal processing (DSP) solutions and analog technologies (semiconductors represent 84% of TI's revenue base). Headquartered in Dallas, Texas, the company's businesses also include materials and controls, educational and productivity solutions, and digital imaging. The company has manufacturing or sales operations in more than 25 countries and, in 1999, derived in excess of 67% of its revenues from sales to locations outside the United States. In the past few years, TI has sold several non-core businesses to focus on DSP solutions and analog technologies, where TI is the world leader. DSP and analog devices have more than 30,000 customers in commercial, industrial and consumer markets. TI faces intense technological and pricing competition in the markets in which it operates. TI's expectations are that the level of this competition will increase in the future from large, established semiconductor and related product companies, as well as from emerging companies serving niche markets. Prior to the implementation of ERP, TI had a complex suite of stand-alone nonintegrated marketing, sales, logistics and planning systems consisting of thousands of programs that were based on many independent databases and running on proprietary mainframe systems.

Overview

Since the 1980s, TI had used a highly centralized infrastructure utilizing proprietary mainframe computers for meeting its IT requirement. As the first step toward global business processes, certain planning processes and systems were standardized in 1989. However, the systems were independent of one another and were, therefore, inadequate to meet changing customer demands. Market conditions dictated that TI must operate as a global DSP business, with greater flexibility, shorter lead times and increased productivity to meet customer demand. The company determined the need for dramatic changes in its technological infrastructure and its end-to-end business processes, in order to achieve these business goals. Starting in 1996, TI underwent a company-wide reengineering effort that led to the implementation of a 4-year, $250 million ERP system using Sun Microsystems' hardware platform, SAP AG's ERP software, i2's advanced planning tools and Andersen Consulting's implementation process (see Figure 1 for a summarized time line).

In 1998, Texas Instruments implemented the first release of the ERP system, which primarily consisted of a prototype implementation of the i2 system running on a Sun E10000 platform. This was the first step toward migrating the manufacturing and planning of TI's orders. In early 1999, TI began rolling out the second release. The initial deployment included the SAP procurement and materials management module and the financial management and Reporting module. In the middle of 1999, TI completed the i2 Technologies software implementation as part of the third release. Finally, TI turned on the remaining financials and new field sales, sales and distribution modules. Included in this release were the first Web clients to be used with SAP and a next-generation, distributor-reseller management system, both developed in conjunction with SAP.

A high-level architecture of TI's pioneering ERP implementation consists of SAP and the i2 system for advanced planning and optimization (see Figure 2). The system is a pioneering, large-scale, global single-instance implementation of seven modules (finance, procurement and materials management, logistics, planning, field sales, and marketing) for all of TI's divisions, and it is in use by 10,000 TI employees to handle 45,000 semiconductor devices and 120,000 orders per month. As shown in the figure, this solution also enabled global Web access to information for TI's 3,000 external users at customers,' distributors,' and suppliers' sites. In total, over 70% of the business transactions conducted with TI by all customers and partners are now via the Web or electronic data interchange (EDI). In summary, the implementation:

- institutes standardized process to support the market trend of order-anywhere/ship-anywhere services;
- provides global visibility of the system to customers and suppliers, permitting them to conduct many activities via the Web; and
- standardizes key information technology systems so as to support business goals.

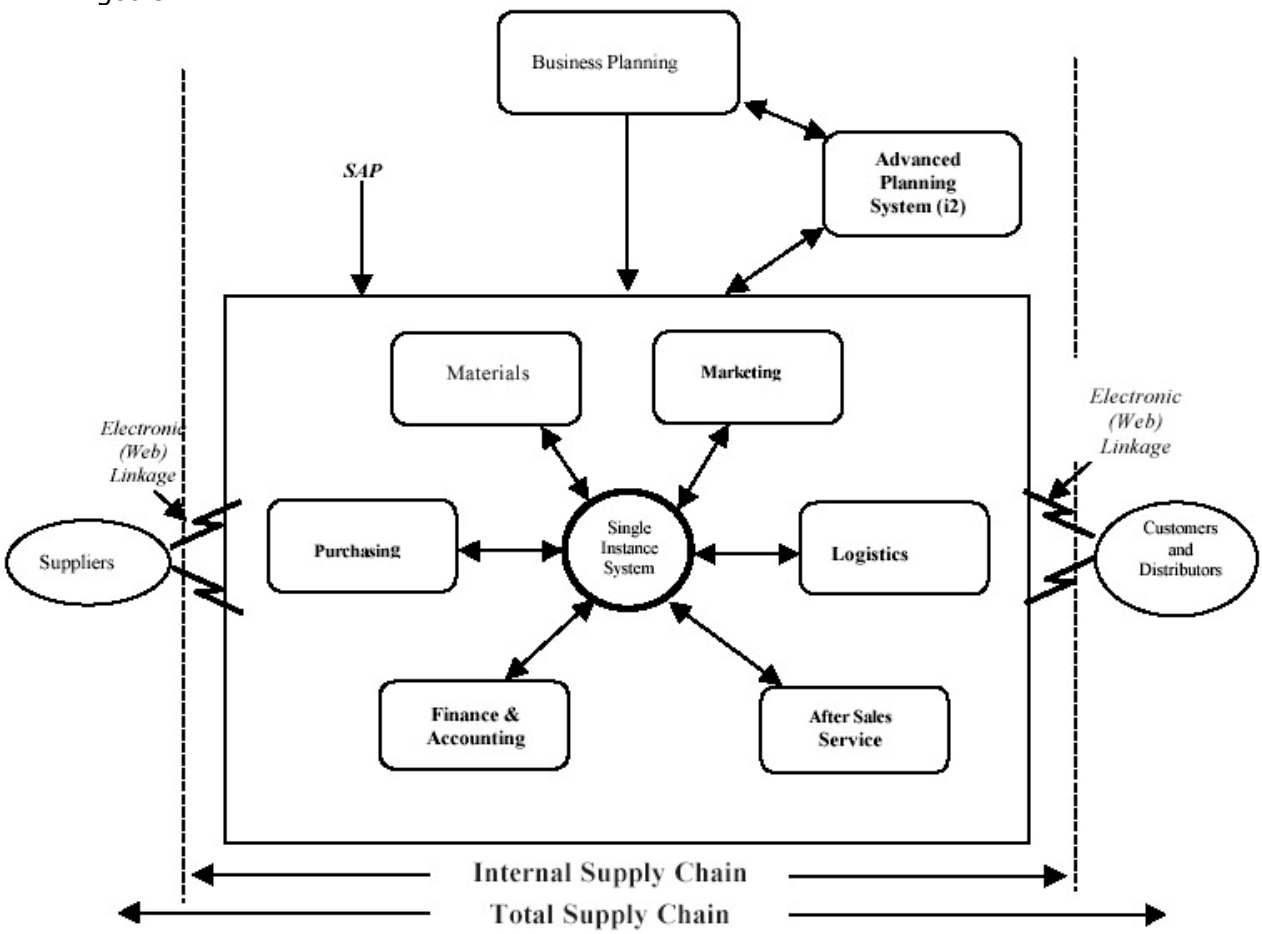

Figure 2: A conceptual model of the ERP system and linkages

The next two sections describe some of the activities involved in the substages of this large-scale implementation.

STAGES IN MANAGING THE GLOBAL ERP SYSTEM IMPLEMENTATION

We now describe TI's activities in each of the stages of the strategic framework that was generally described earlier in this case.

Strategy Formulation

Traditionally, TI was primarily running what was called a "commodity" business, wherein orders were received, manufactured and shipped as a batch. Throughout the 1980s and '90s markets evolved from the one-size-fits-all status to one in which customers started demanding customized products. This mass customization phenomenon, combined with the maturity of TI's business, caused it to reexamine its goals and strategies. TI started its shift towards a more customized product environment.

Within this new customized product environment, TI had a number of customer needs that could not be met easily. For example, a customer in Taiwan wanted to place all orders in California and then allocate a worldwide destination for the ordered products only at the time of shipping. This was difficult for TI to coordinate because each of the regions was on a separate system. Other customers wanted to place orders for complete sets of devices that all worked together. Since its existing system could not handle such orders, TI had to enter the order for each device separately. The delivery of each of the devices was done at different times, implying that the customer will have to carry inventory while waiting for the remainder of the set. Manual workarounds and interventions were needed to handle these kinds of demands. Thus, the goal was to determine the appropriate processes and information systems that had to be put in place in order to support such agile design and manufacturing strategies (see, for example, Peters & Saidin, 2000, who describe the use of IT for supporting mass customization).

Another goal was a move toward supplier-managed inventory and customer-managed orders. Going beyond EDI and extending e-commerce meant that TI decided that leveraging the capabilities of the Internet to provide visibility of its systems to its customers and suppliers would be necessary. Finally, standardizing systems was another integrative corporate goal. TI's strategy was to ensure standardization of its systems as much as possible. Specific areas such as factory automation were left to use custom solutions, but other areas such as planning were required to be on standardized open systems in order to support the other goals.

TI makes extensive use of metrics. Strategic goals are translated into tactical and operational quantifiable objectives. Key metrics are developed and used as a fact-based management approach that keep clarity in the project direction and manage the scope of the project. The metrics include standard operationally and organizationally strategic ones, such as time, cost, flexibility and quality. In addition, since TI's manufacturing equipment is very expensive, its management made it clear that it was also concerned with level of use–utilization–of the organizational equipment.

Process Planning and Systems Design

TI conducted a massive reengineering effort for the whole organization with the goal of setting standard processes globally. The major result of this effort was to declare that

all inventory and manufacturing management be done globally. This process change caused the practice of earmarking a production lot for specific customers to be discontinued. There were thousands of programs in use at that time, and this proliferation of stand-alone systems inhibited the implementation of global processes. Thus, a proposal to implement an ERP system was made to the president and other strategic business unit managers.

Many organizations find multiple-instance implementations more flexible and sometimes easier to implement. Yet TI decided to implement a single-instance ERP system so as to fully leverage the system's capabilities to support the flexibility and standardization demanded by global processes. After site visits by major ERP vendors, TI selected SAP, mostly because of its scalability to handle voluminous amounts of data. Yet, the actual selection and justification included the evaluation of a number of systems by TI. These systems were evaluated through a questionnaire that contained hundreds of detailed questions pertaining to capabilities, ranging from user friendliness to support of major functions. Many of these same questions were used in aiding in the system justification.

System Justification

A budget of approximately $250 million was set for the implementation. The justification of the system was done using a combination of tangible and intangible factors at both the enterprise and business-unit levels. Standard hard- justification measures such as ROI and IRR were used to ensure the financial viability of the project. In fact, if these were the only measures to be used, then the system would have been justified. Yet, the data for these measures were still forecasts and estimates. Strengthening the financial justification by evaluating other measures and factors helped to provide a stronger foundation for managerial acceptance. In estimating financial measures, global capacity utilization as a result of the ERP system was also projected. The project managers kept in mind that such projections were only guidelines that could get offset or boosted as a result of other continuous-improvement activities that were ongoing in the company. These estimates ranged from 3-5% output improvements based on current assets, which although seemingly small, amounted to increased cost savings of several hundred million dollars. Some additional intangible and tangible factors included:

- TI's proprietary mainframe-based ordering was incompatible with the goal of moving toward a Web-based e-commerce model.
- TI had thousands of programs that incurred huge maintenance costs, such as integration, among these software systems.
- Accurate global inventory was not possible without a "single-instance" ERP system.
- An ERP system would facilitate in cycle-time reduction, which would help TI compete effectively in the custom DSP market.

Through this business case justification, acceptable financial returns, along with strategic factors, such as competing effectively within a given niche market, and operational factors, such as global inventory management, all played a role in ERP's justification at TI.

System Configuration

The goals and processes described above entailed a number of changes at the detailed level. Many of the changes are difficult to manage because of drastic changes needed to the ways of doing business (e.g., the business rules). The processes used to address the arising conflicts range from top-management-enabled dialogue among the participants to top-management-backed decisions that laid down the policy for TI. A few examples follow:

- All inventory is global. For example, inventory in Europe must ship, if needed, to any part of the globe, rather than be held for European orders that can potentially come at some time in the future.
- The number of levels of approval on a purchase order was standardized at four (there were some countries that had 15 levels).
- Authorization amounts were standardized according to the level of the concerned person in the organization.
- An 18-character, globally accepted part number became an agreed upon standard. This standardization involved a huge IS and business effort because changes had to be made to the databases, programs supported by them, and some manufacturing procedures, in addition to having to communicate the changes to the customers.
- All systems were mandated to be in English except for customer-specific information such as addresses, etc., used for external communication with them. In general, English was used when information was to be shared among multinational facilities, while local data, specific to a facility, could be in the local language.

Implementation

In this phase, concepts and goals are translated into tangible action, and as a result, it is perhaps one of most difficult phases of the project. General principles such as global processes and standard systems need to be backed up by convincing and deploying the right people to implement the processes.

We briefly describe TI's implementation phase in the following categories, start-up, project management, and "going live." This description contains the manner by which problems were addressed in each category.
Start-up. A number of key personnel, along with their families, were expatriated to the US and stationed in Dallas for a few years. About 250 people were transitioned from TI to Andersen Consulting (i.e., put on Andersen's payroll), which became the main provisioner of services with respect to the ERP system. IT outsourcing in this case involved Andersen Consulting taking over the employment and management of former TI people.

Project Management. Change management played a large role in this stage. The roles of training, planning, and communicating were of equal importance. All management levels were involved in this process, as were various vendors and suppliers. Some of the practices included:

- On-site experts were made available to new users of the system.
- A help desk was set up to handle problems that could not be addressed by these experts.
- A ticketing system for managing and prioritizing problems was also established (e.g., a system stop was a high-priority ticket that would get round-the-clock attention).

Handling Go-Live. To get prepared for "go live," the key managers who were stationed in Dallas were sent back to their territories for educating the next level of users. Using selected experts, user-acceptance scripts were defined and tested, with problems, if any, being resolved as per one of the schemes outlined above. Daily conference calls were set up for 30 days prior to go live to obtain status checks on progress and on the tickets.

Based on the results of these checks, a risk analysis was conducted weekly to determine the effects of various potential failures. The implementation plan was to have a few go live dates one after another, but in relatively quick succession. Except for the planning system, in all the other stages in this case a direct conversion was employed. That is, with a downtime of about 2 to 3 hours during a weekend, the old system was turned off and the new one turned on.

Post-Implementation Status

The system met most of its goals 9 months after the complete implementation. Response time for the system has exceeded expectations, with 90% of the transactions worldwide getting a response within 3 seconds. There are around 13,000 users (10,000 TI + 3,000 outside) on the system, with concurrent users ranging from 300 to 1,700. The integrated system allowed TI to better manufacture and deliver its 120,000 orders per month involving 45,000 devices.

Some of the key performance measures and parameters evaluated were:

Productivity dip. There was a period of reduced productivity. Given the voluminous changes involved, this was to be expected. TI expected this and discussed with Andersen methods to ameliorate this problem.

On-time delivery. TI was not hitting its goal of on-time delivery. In addition to the new system, market conditions caused more orders than they could deliver. They were falling short of capacity.

Single-instance global system. The single-instance, integrated global model was successful, fundamentally transforming how business is conducted at TI.

Better response. Because of its Web capability, the system is used by TI's external constituents as well, namely, distributors, customers, suppliers, and field salespeople worldwide. This Web capability allowed easier-to-use order management systems for customers. Customers no longer had to use TI-specific software applications and/or costly point-to-point connections.

*Inventory reduction. S*ome TI factories reported output increases of 5- 10% and up to 15% reduction in work-in-process inventory.

MANAGERIAL IMPLICATIONS

This case study of a successful ERP/e-commerce implementation offers and reiterates a number of lessons for the management of these systems. The following lessons are summarized:

Conduct a Thorough Strategic Plan–The case illustrated how market forces had compelled the company to make radical shifts in its organizational environment and culture.

Align IT Plans With Business Plans–Conduct reengineering studies and develop strategic IT plans to align key IT needs with those of the business.

Get Top Management Support–The prescription of top management support has been made ever since early IT implementations (O'Toole & O'Toole, 1966) to the present. Strangely enough, as stated by Jarvenpaa and Ives (1991), it also remains to be one of the prescriptions that has been regularly ignored. In this case, TI's president and the chairman of TI's board communicated the importance and status in their quarterly satellite broadcasts to the company. The president sat in on quarterly meetings and even stipulated that if anyone wished to "customize" aspects of the system that they would have to personally explain it to him and show why TI would get more profit out of this change.

Change Management–Set realistic user expectations such as the initial productivity dips. User involvement is critical. Andersen Consulting's process helped to ensure that such was the case. Make sure that the user is supported to help improve user satisfaction.

Strong Champion Characteristics–In TI's situation, the manager of the ERP project had over two decades of experience in various levels of the organization. This manager had broad knowledge of corporate operations since he was in charge of the previous business process reengineering programs that formed the foundation of the new ERP system. Previously he was a vice president of one of TI's divisions.

Rationalize Business Models and Processes–Make sure the business models and processes fit within the strategic direction and goals of the organization. Time, mass customization, and flexibility concerns led to a global model. Part of this rationalization was also completed after the SAP system was agreed upon, since SAP required business processes to be completed as specified by them or significant customization of the system would be required.

Manage External Enterprises–Appropriate and well-planned involvement of consultants is important for keeping the project on a tight schedule. Further, with the advent of e-commerce, companies are more likely to ship and order goods on the basis of Web-based inputs (Kalakota & Whinston, 1996). A training program must encompass such constituents as well, an aspect that seems to be ignored in the research literature. Managing external enterprise relationships (and systems) is not something that many organizations have had experience completing. This makes the e-commerce setting more complex, especially when organizations seek to integrate interorganizational systems.

Manage Using Metrics–TI and Andersen Consulting have a corporate culture and policy that requires the stringent and formal use of metrics in the management and evaluation of projects. They attribute this policy adherence as one of the key reasons for success of the ERP implementation.

CONCLUSION

Traditional information systems are often implemented with the goal of improving the internal productivity of an organization. In contrast, modern enterprise and inter-enterprise systems have supply chain integration as an additional and an increasingly critical goal. This makes their management and implementation a very time-consuming and difficult task. TI's ERP implementation with an e- commerce perspective compounded these inherent difficulties by requiring additional features.

- It is a single-instance system, providing access to the same data, irrespective of the geographic location of the user.
- It provides access to 3,000 external users (customers and suppliers), thereby enabling 70% of the transactions to be conducted electronically.

Management did see some problems in this implementation process and tried to address the issues. Some of the major problems included:

1. The software for supply chain management (Red Pepper) that was initially chosen did not meet expectations of TI. This system had to be scrapped; this resulted in a multimillion dollar cost. The i2 system was then implemented.
2. A productivity dip did occur. The implementation had to address this issue for all managers throughout the organization who had some stake in the performance of the system. The expectations that this would occur were communicated through newsletters and messages. Consistent and continuous communication helped to mitigate a situation that could have caused a major project failure.
3. Getting buy-in from internal functions not directly associated with the implementation process was difficult. This occurred with the marketing function. This function needed to be on board for the e-commerce linkage with customers to work effectively. Training and pressures from upper-level management helped to ease the transition for the global marketing group.
4. Engineering is still not fully integrated into the ERP system. The e-commerce linkage incorporating product design with the ERP system was not feasible for management. For such a technology-driven organization, the lack of engineering function integration with the ERP system may need to be investigated.

Key questions to consider:

1. Can a large multinational organization implement a single-instance global ERP system without the aid of an outside consultant? Could they manage this process even after implementation? Is outsourcing the IS function for ERP a good idea?

2. Which functions are critical within a global ERP system? Why would engineering not be considered a central function for e-commerce? Why should it be?
3. What metrics could be considered for system selection, system implementation, system auditing? Would these be the same metrics? Can e-commerce-based metrics be used? What type of e-commerce based metrics may exist?
4. What lessons could be learned from TI's implementation process that could be used for future module integration? How much interorganizational system integration is required for TI in the ERP/e-commerce system linkage?

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Chapter IX: An Object-Oriented Awareness-Based Methodology for ERP

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INTRODUCTION

It is now believed that success of ERP systems is largely dependent on not only the successful evaluation, selection, implementation and post-implementation of ERP systems, but also on integrating it with the organizational business processes. On the other hand, nearly all business processes are collaborative in the sense that multiple human agents or *actors* interact with one another for achieving one or more process goals. As a result, one can claim that one major factor in successful implementation of the ERP systems is development of appropriate conceptual models of the ERP process from various perspectives. In this chapter the writer, being a member of the CSCW (computer supported cooperative work) research community, introduces a conceptual model for ERP which has an emphasis on the collaborative nature of ERP process that explicitly addresses the "awareness" and "knowledge-sharing" issues within the ERP process. This conceptual model demonstrates collaboration requirements of the actors behind individual business processes as well as the relationships among these business processes. This chapter is intended to introduce to the ERP community a relevant piece of work in conceptual modelling from the perspective of CSCW with the aim of attracting research collaborators for further investigation in these fields.

A major research work by the author is in progress for developing an expert system that enhances collaboration among various entities within an enterprise through providing these entities with required levels of awareness. This chapter introduces the conceptual model that constitutes the bulk of the inference engine of this Expert System when applied to the enterprise resource planning.
Like many existing ERP frameworks/models, the proposed framework is also based on a widely accepted assumption that a corporate-wide information system consists of a set of potentially related subsystems. As a result, information flows among these subsystems must be identified and required resources be planned using an appropriate ERP methodology. What makes the proposed framework unique among others is that it explicitly treats an ERP process as a *collaborative process* by modelling the process using collaborative semantic concepts. This conceptual model consists of multiple interrelated subprocesses with each subprocess in turn being composed of one or more simple tasks (as opposed to the collaborative tasks explained later). For simplicity, simple tasks are referred in this chapter as *tasks*. Each task requires certain resources for achieving its local goal or purpose, as well as certain other resources for achieving its collaborative goals with other tasks within the ERP process. The term *process resource* is the term used to describe the resource required for performing a task with no regards to its collaborative resource requirements, whereas *collaborative resource* is used to describe additional resources required by a task in order to collaborate with other tasks. Each task is performed by a *role* and each role is played by a human agent called an *actor*, although there is no representation for the *actor* in the framework, and the actor is indirectly identified through the *role* that they play at any time. Actors may

play multiple roles in an ERP process. When more than one role performs a task, then we call the task a *collaborative task* that consists of a pair of (simple) tasks, each played by a different role and as a result, that would require an additional set of resources in order for the collaboration to be realised.

Another unique characteristic of the proposed framework is that it regards effective communication or information/resource exchange among the actors as being closely related to the level of awareness that each actor possesses about other components of the collaborative process (e.g., roles, subprocess tasks, process resources and collaborative resources). In other words, both the proposed framework and its derived ERP methodology are based on the awareness of human agents, where such awareness is defined in terms of the knowledge about various aspects of the ERP process itself. Have a look at this familiar scenario:

"If our systems had been communicating, the instant the record closed out in our system the sales guys would have known it ... There are three forecasts for monthly sales and I couldn't reconcile them. Accounting uses some kind of dollarized forecast for cash planning purposes. The sales guys are using their Quija boards and other sorcery to figure out what deals they will close. ... Entering the data, especially since it is done only once, requires extensive formal procedures". (Jacobs & Whybark, 2000, pp. 12-13)

And finally the last unique characteristic of the proposed framework is that due to its object orientation; it encapsulates all complications and dependencies among subprocesses of the ERP process within the individual tasks and required to perform those tasks, and further relieving ERP management and the associated software.

A PROCESS AWARENESS METHODOLOGY FOR ERP

This section introduces a methodology for identifying awareness requirements of actors in an ERP process. Such requirements can then be used to plan various resources within the enterprise. The steps for this methodology follow:

STEP 1. Develop a conceptual model for the ERP process using a set of collaborative semantic concepts. This model shows all the activities within the enterprise in the form of various tasks that are performed by actors by assuming certain roles using two categories of resources: process resources and collaborative resources. This conceptual model is called the *ERP process map*. Detailed description of the ERP process map is given later.

STEP 2. Measure the *actual levels of awareness* of each role (or the actor who plays the role) on the ERP process map using the awareness model. Actual level of awareness is a property of the actor, and the role simply inherits such awareness from the actor who plays it. Depending on its numeric value, this actual level of awareness may consist of a set of instances/objects emanated from the collaborative semantic concepts/classes that constitute the ERP process map. These concepts/classes are:

i. roles,
ii. tasks,
iii. process resources, and
iv. collaborative resources.

As an example, We may identify the following subprocesses/subsystems in an ERP collaborative process:

Financial Accounting (FA)

Order Processing (OP)

Customer Service (CS)

Financial Reporting (FR)

We can say that FA subprocess consists of a set of *tasks* identified by FAT1, FAT2, ... FATn; OP consists of the tasks OPT1, OPT2, etc. Role R1 may play FAT1, FAT2 and OPT1 whereas role R2 may play FAT4, FRT1 and FRT6, etc. R1 needs *process resource* PR_R1FAT1 for performing FAT1 task (shown by an arc connecting R1 to FAT1) and R2 needs process resource PR_R2FRT1 for performing FRT1 task (shown by the arc connecting R2 to FRT1), etc. Let us assume that the two tasks FAT2 and FRT1 are executed collaboratively and for this collaboration to occur a *task resource* TR_FAT2_FRT1 is required shown by an arc connecting FAT2 to FRT1. A graphical representation of this ERP process is shown in Figure 1.

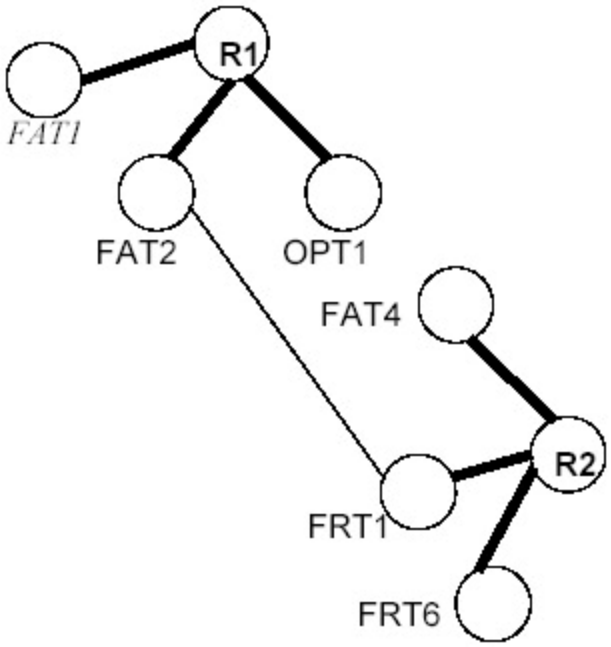

Figure 1: An example of an ERP process map with two roles, six simple tasks, and one collaborative task

In order to measure the actual level of awareness of an actor s/he must be exposed to all the objects that exist on the ERP Process Map and be asked to identify those objects that s/he is aware of. A Selected pool of objects is then fed to the algorithmic procedures (the second component of the proposed framework) in order to arrive at a number that reflects the actual level of awareness associated with the role. These levels are explained in the next section in more detail.

STEP 3. The actor's actual level of awareness is then compared against the *required level of awareness* as specified by (or being a property of) the task that the actor plays

(through assuming a role) within the process. It is assumed here that each task object has a *required level of awareness* as its most major property. This level of awareness is the minimum level of awareness that is expected from any role who intends to perform the task. A knowledge engineer will determine the value of this property. The factors that may affect the knowledge engineer's decision in deciding on this value are organizational culture and the nature of task itself. This value reflects the fact that without such awareness the actor will not be able to perform the task properly. A comparison between the actual level of awareness of the actor and the required level of awareness of the task will result in one of the following two outcomes:

1. The required level of awareness of the task is either equal to or less than the actual level of awareness of the role. This indicates that the role is qualified or has sufficient level of awareness for taking up the task as the awareness requirements of the task are satisfied.
2. The required level of awareness of the task exceeds the actual level of awareness of the actor. This indicates that the role does not possess required awareness and therefore various (missing) objects, including instances of process resources and collaborative resources, must be put within the focus of the actor that s/he is not aware of them yet. In other words, required resources are needed to enhance the awareness level of the actor in order to perform the task effectively. These required resources may include one or more of process resources, collaborative resources, and other communication resources, e.g., resources that provide awareness about other roles and other tasks, within the ERP process.

COMPONENTS OF THE FRAMEWORK

The proposed framework consists of the following two components:

1. a connected graph as a conceptual model for the ERP process (called the ERP process map), and
2. a new model for *process awareness* in the form of a set of algorithmic procedures that can be used to parse the above graph in order to identify various objects that constitute various levels of awareness associated with various roles and tasks within the ERP process.

Process Map

The ERP process map is a planning and analysis tool that models the ERP collaborative process using a limited number of *collaborative semantic concepts* (or *objects*) that are linked together through various resources. These primary concepts and their related secondary concepts include the following.

Task (Also Called "Simple Task")

Definition: objects with a set of attributes and *actions* to achieve a specific process goal using certain resources called *process resources*.

Representation: It is uniquely identifiable by a combination of one or more of its attributes (e.g., goal, ID number, Required Level of Awareness, etc.) and/or its actions.

Simple tasks are graphically represented by vertices of a connected graph, which represents the ERP process. Figure 2 shows two processes. The one in the top is collaborative (has many collaborating roles/actors) and the bottom one is a non-collaborative process map. Tasks are shown by bold circles labelled a to f and 1 to 8.

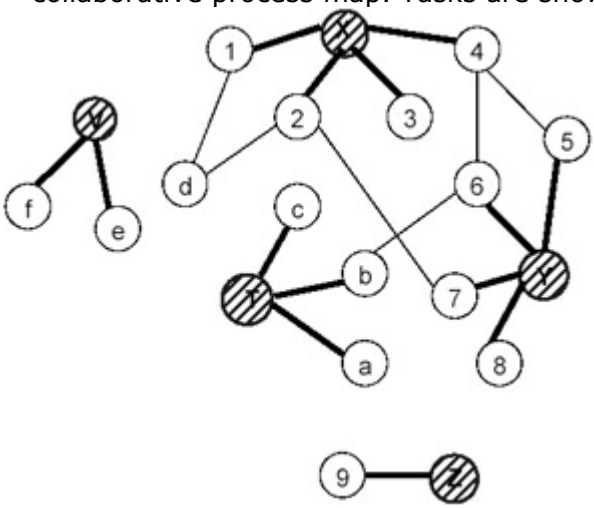

Figure 2: Example of collaborative and non-collaborative processes

Action
Definition: a sequence of goal-directed steps.
Representation: Actions are secondary concepts in the proposed framework and therefore there is no direct graphical representation for the actions. They are embedded within the task.

Collaborative Task
Definition: is composed of two (or more) *simple tasks* that share the same *collaborative resource* and have a common goal.
Representation: Collaborative tasks are graphically represented by the associated simple tasks and the shared collaborative resource arc that links the tasks together.

Actors
Definition: These are human agents that enact a set of simple tasks by playing a set of *roles*.
Representation: There is no direct graphical representation for these objects. Actors are embedded within the *roles* that they play within the process.

Role
Definition: a set of norms expressed in terms of obligations, privileges, and rights.
Representation: Roles are graphically represented by vertices of the connected graph. In Figure 2, roles are shown by filled circles.

Process Resource
Definition: This object represents the resources that the role utilises in order to perform a *simple task* in isolation.
Representation: Process resources are graphically represented by the arcs that connect a role vertex to a simple task vertex.

Collaborative Resource
Definition: These are resources used by the actors (usually a pair of actors) in order to perform a certain simple task in collaboration with another actor playing a related simple task.
Representation: Collaborative resources are shown by arcs that connect two related simple task vertices together.

Process
Definition: a set of roles, process resources, simple tasks, and collaborative resources that are linked together in order to achieve certain enterprise- wide goal. ERP processes are formed when two or more *actions* require certain *collaborative resources* at the same time. This is called *task dependency*. Task dependency may exist both within and between the subprocesses of the ERP process.

Representation: An ERP process is graphically represented by a connected graph similar to the one at the top portion of Figure 2. An ERP process is *collaborative* if at least one *collaborative task* exists in it. It seems that ERP processes are always collaborative.

Awareness
Definition: Awareness is specialised knowledge about the objects that lead an actor to an understanding of various aspects of the process. Contents of this specialized knowledge are defined in terms of various roles, simple and collaborative tasks, and process and collaborative resources.
Representation: Graphical representation of various levels of awareness of an actor includes a set of the objects (or collaborative semantic concepts) that constitute various paths from the actor's role vertices to each other vertices of the process' connected graph.

Actual Awareness: is the awareness that an actor actually possesses within the process. Actual awareness is represented by an integer number, ranging from 0 to 6, representing various levels of awareness.

Required Awareness: is an awareness that is attached to each task and represents the expected awareness from the actor who performs the task. Its representation is the same as actual awareness.

THE AWARENESS MODEL

The awareness model provides a new definition for *process awareness* within the context of collaborative process, as well as a measure for this awareness. The awareness model defines *awareness* levels in terms of the collaborative semantic concepts. According to this model, *process awareness* is knowledge about the objects that lead an *actor* to an understanding of various aspects of the *collaborative process.* Such awareness is defined in terms of structures that may include *roles, simple* and *collaborative tasks*, process resources, and task resources. These levels are:

Level-0 awareness: An actor's level-0 awareness is awareness about the objects that lead the actor to knowledge about all the *simple tasks* that the actor performs within the process.

Level-1 awareness: This is the sum of an actor's level-0 awareness plus awareness about the objects that lead the actor to knowledge about other related roles within the process.

Level-2 awareness: An actor's level-2 awareness is his/her level-1 awareness plus an awareness about all other (or the rest of the) *roles* within the process. Level-2 awareness is knowledge about the human boundary of the process.

Level-3 awareness: An actor's level-3 awareness is his/her level-2 awareness plus awareness about all the interactions (represented by the *task artefacts*) that occur between any two roles within the process.

Level-4 awareness: This is the highest level of awareness that an actor can have about the internal components of the process. It is defined as the knowledge about how everything fit together to form the process. In other words, having this level of awareness will bring all the remaining objects in CBPM within the focus of the actor.

Level-5 awareness: is a knowledge about the objects that lead the actor to an understanding of the actual relationship between the process and the overall organizational context. No process map representation exists for this level of awareness. This level represents the theoretical limit of the proposed framework, and its appearance in this article is simply due to its fitness to the overall evolutionary nature of the awareness. No further discussion will be given regarding this and the next level of awareness.

Level-6 awareness: is a knowledge about the objects that lead the actor to an understanding of the history of the process at different times as well as in similar organizations at present time.

APPLICATION OF THE PROPOSED FRAMEWORK TO ERP

On the basis of this framework the writer is in the process of developing a knowledge-based system that provides expert advice for answering the following two main questions:

1. In terms of awareness requirements, is an actor capable of performing a certain task within the ERP process?
2. If not, what objects need to be put within his/her focus in order to enable the actor to perform the task properly?

These questions are elaborated in the following paragraphs.

Analysis of the Framework

In the example of Figure 1 the ERP process has four subprocesses (that is, Financial Accounting, FA, Order Processing, OP, Customer Service, CS and Financial Reporting, FR). The notion of a subprocess is encapsulated within the individual tasks and relevant resources of the subprocess (no direct representation for subprocesses in the framework). Instead, each task possesses a set of attributes and relevant actions that will indicate to which subprocess the task belongs. This will provide a sense of separation/freedom to an actor to play various roles within different subprocesses without being permanently linked to a specific subprocess, a factor that can greatly

contributes to much of complexities of an ERP system. The interdependency issue between various subprocesses is also simplified by encapsulating them within the task objects and their related resources in such a way that each task has equal opportunity (or follows the same standard) to be linked to any other task within the ERP process, including to those tasks within the same subprocess. This will also reduce much of complexities that may exist in process-oriented ERP systems where the system must permanently maintain such linkages.

CONCLUSION AND FUTURE WORK

This article introduced a conceptual object-oriented approach framework based on process awareness for analysis and design of ERP systems, and its advantages over process-oriented systems were discussed. The same framework has already been used for designing more general purpose knowledge- based systems that maintain awareness levels of actors at desired levels (Daneshgar, 1999, 2000). In addition, the framework has also been successfully applied to a trouble ticketing process in a large network organization in order to identify improvement priorities within the network management process. The process has also been applied to other collaborative processes e.g., "The University Tutorial Classes" and "Software Development Life Cycle process in distributed environments," with significant results. The framework and its awareness model component have been calibrated for different organizational cultures (Daneshgar, 2001).

Work is in progress for finalising development of a general purpose knowledge-based system that can provide expert advice in relation to the collaborative aspects of business processes.

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Chapter X: A Framework for Assessing ERP Systems' Functionality for the SMEs in Australia

OVERVIEW

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Anticipating the use of ERP systems among small to medium enterprises (SMEs) to be the future area of growth, ERP vendors such as SAP, Oracle, PeopleSoft, J.D. Edwards and Bann are introducing ERP software that appeals to the market segment of the SMEs. Introduction of the ERP systems for SMEs includes compact packages, flexible pricing policies, new implementation methodologies, and more specialized functionalities. The strengths-weaknesses-opportunities-threats (SWOT) framework of the ERP software offered by the aforementioned vendors for the SMEs requires in-depth analysis based on real field data. The aim of this study is to identify the strengths, weaknesses, opportunities, and threats of ERP systems offered by the five leading vendors for the SMEs in Australia. Multiple case study design approach is used here for collecting the primary data from the ERP vendors. A SWOT framework is developed to study the functionality of the ERP systems offered by these vendors. This framework may guide the managers of SMEs in selecting and implementing ERP systems for their organizations.

INTRODUCTION

Integrated, streamlined, responsive and agile are words being used to describe what companies must become in order to stay profitable. Enterprise resource planning (ERP) can be regarded as a key enabler of business transformation. It is also regarded as a critical success factor (CSF) to the survival of any business in this highly competitive marketplace. More than 60% of the Fortune 1000 companies have installed or are in the process of implementing packaged ERP systems to support their back-end business activities (Kraft, 1999). These packages implemented by the Fortune 1000 companies run well over the IT budgets for Australian SMEs. ERP vendors are targeting this market with supposedly scaled-back systems suitable for smaller firms. The question of how well these packages target the SME needs is the central focus of this study.

ERP is being sold as an essential tool for the survival of any commercial organization in the future. The SME is the new target of ERP vendors offering systems refined specifically for this untapped market segment. SME managers are faced with the highly complex task of sifting through these software packages to see what is on offer and how it may benefit their organization now and in the future. To appraise such complex systems for the benefit of the SME market segment requires a guiding framework.

Therefore, this study aims to develop a SWOT (strengths-weaknesses-opportunities-threats) framework for evaluating the functionality of ERP systems available to Australian SMEs. The focus of this study is to develop an understanding of the systems offered by the five leading vendors–SAP, Oracle, Peoplesoft, J.D. Edwards and Baan. This provides not only a comparison of the ERP products offered by five leading vendors, but also provides a normative framework that can be used to assess packages offered by other vendors. Further, the relative strengths, weaknesses, opportunities and threats of this functionality provide SME decision makers with a framework for choosing and implementing the system that is best for their business.

DEFINITIONS OF THE CONCEPTS USED IN THIS STUDY

Assessment

Assessment pertains to judging the quality or worth of a certain aspect or object. In our study, assessment will be conducted using a management tool known as a SWOT analysis. SWOT analysis is a widely used framework for organizing and utilizing the information gained in analyzing a complex system and its environment (Frenzel, 1996). It is a general tool designed to be used in the preliminary stages of decision making and as a precursor to strategic planning (Hossain & Shakir, 2001).

For the purpose of this study, a SWOT analysis is defined as an evaluation of both the internal strengths and weaknesses and associated environmental opportunities and threats of ERP software packages on offer to Australian SMEs. A SWOT analysis is therefore a tool which provides an overall picture of both the present functionality and the future tendency of each ERP software package. It relates vendor offerings and market needs in a way that gives the best understanding of the external factors, threats and opportunities, coupled with an internal examination of strengths and weaknesses of the software.

ERP

Enterprise resource planning (ERP) systems are potentially large and complex information systems. ERP is a strategic use of computing and communications hardware and software to leverage technology in order to gain competitive advantage and increased productivity. ERP integrates a company's business processes and existing computing systems into a uniform set of business applications. It involves reengineering the way an organization functions in order to make it more efficient, automated and cost effective.

Vendors

In this study, vendor refers to a large software development company. These companies also undertake a substantial amount of marketing, research and development, support, sales and training in order to back their multi- million dollar products. The five vendors considered in this study are SAP, Oracle, PeopleSoft, J.D. Edwards and Baan. These are the largest players in the market with substantial investment, knowledge and experience in ERP systems for large companies.

Functionality

Functionality is the core of this report. It is what the vendors are selling and the SMEs are buying. It is the commodity to be appraised by the SWOT analysis.

SME
The Australian Stock Exchange Web site (www.em.asx.com.au) describes SMEs as an unlisted entity employing between 1 and 250 people. EFIC defines an Australian SME exporter as having total annual sales less than A$50 million, with a small exporter having total sales less than A$5 million. The Australian government classifies an SME as returning an average revenue of A$250 million. There are some 10,000 SMEs in Australia with growth potential, which represents approximately a $5 billion market.

The aim of this study is to find some alignment between SME needs and what the ERP vendors are offering. The SME decision makers have some picture of what they want from the product, their requirements. The ERP vendors also have some data about the market to which their product is targeted. The overlap between these two perspectives is the functionality of the ERP system.
This view of the problem leads to a SWOT in which strengths and weaknesses represent the extent to which SME needs match the ERP product offered by the vendors. Opportunities and threats are related to the changing business conditions, legislative trends, best practice models and technology changes that may change this picture. The next section provides a discussion of three theoretical perspectives–critical success factor (CSF), joint application design (JAD) and business systems planning (BSP)–and presents the reasons for choosing the CSF perspective. The section then presents the theoretical framework from which the conclusions are drawn.

THEORETICAL FRAMEWORK FOR THE STUDY

A detailed description of each of the three theoretical assessment perspectives, JAD (joint application development), CSF (critical success factor) and BSP (business systems planning), together with its trade-offs, advantages and disadvantages is presented. A rationale for the selection of CSF as an assessment choice for understanding the functionality of ERP systems for the SMEs is provided.

JAD (Joint Application Development)

JAD is a process where decisions can be made through a series of highly structured group meetings (Avison, 1992). These meetings usually take place for an extended period of time and are usually isolated from normal meeting places. The idea of JAD is to obtain a general group consensus on various issues affecting a business/business project.

A JAD group consists of a number of varied roles. There is always a decision maker (usually someone in executive management), who has decision-making capabilities. The group also consists of a facilitator, who leads the JAD sessions.

The facilitator generally possesses excellent communication skills, has an under-standing of the business and can resolve conflict effectively. It is also important for the facilitator to be impartial to all group members, ensuring that members have an equal opportunity to present opinions/ideas. The facilitator will be responsible for planning the session and to some extent leading the other participants.

A broad user/manager base is also chosen for discussion. In contrast to more general focus groups these users may range across several units of the business. This enables communication of business rules or procedures and acceptance or rejection of new ideas. Finally a scribe(s) needs to document the meetings and distribute a copy of all the minutes immediately to all group members following the meetings. This is to establish momentum and enthusiasm for the project. CASE tools and data modeling are often used in documentation. A scribe often liases with IS trained staff who are present during the discussion but often do not voice their opinions.

The JAD session must be held somewhere in isolation from normal business activity that can commonly be a cause of stress for users or managers. Detailed agendas should be prepared and handed out prior to each JAD session. This agenda should consist of an agenda opening, an agenda body and an agenda conclusion, which is formulated at the conclusion of the meeting. Individuals who are participating in the JAD sessions must be selected carefully but also unbiasedly. It is of little use choosing all JAD members from a particular area of the business–this would present a biased and narrow view–but it is important not to select people who would find it difficult to communicate.

JAD encourages ownership in a project by actively involving users and management in the development process. It is a high-level and quick means of developing systems. Finally it allows the benefits of rapid prototyping and feedback from the users. JAD is costly on an organization's time, especially that of management and executive management. Three to five days away from normal business operations can be seen as an unacceptable level of time. Preparations are immensely important; without adequate preparation and leadership the project will fail. Also it will often prove difficult to schedule everyone to an appropriate time, i.e., everyone being able to attend every meeting.

CSFs (Critical Success Factors)

Managers often use CSFs to explicitly identify and state the key elements required for the success of their business operation. There is also an apparent knowledge gap between the CSFs and its definition in relation to the industry types and business operations. An investigation of the existing literature suggests that CSFs are the small number of easily identifiable operational goals shaped by the industry, the firm, the manager, and the environment that assures the success of an organization (Laudon & Laudon, 1998). Rockart (1982) and Rockart and Scott (1984) argue that CSFs are the operational goals of a firm and the attainment of these goals will assure the successful operation. CSFs can also be defined as those few key areas in which things must be correct in order for the firm to remain competitive (Neumann, 1994). According to the most widely used CSF technique suggested by Rockart (1982), it is evident that the usefulness and scope of this framework depend on the subjective ability, style, and perspective of the executives. The shaping of the CSFs can be seen from four viewpoints:

1. can be shaped by the industry and its structural changes;
2. the firm's operational strategies and changes in the products/services offered;
3. the manager and his/her perceptions towards the success factors of a firm; and,
4. changes in environment with regard to technology, computer HW and SW, other external factors like government regulation, changes in the policy.

CSF is receiving considerable attention from both academics and managers. The environmental uncertainty and flooding of the market with changing HW and SW make the manager's investment decisions more complex. Research by Daniels' provides us an early foundation of the CSFs for a firm. Daniels (1994) definition of CSFs is focusing on the 3-6 areas that a company must do in order to succeed. Rockart (1982) expanded the definition of CSFs in a broader context, taking the existing viewpoints of Daniels and suggests that CSFs are a limited number of factors that ensure successful competitive performance by the organization if implemented.

Although CSF is a fairly straightforward framework it does have a few disadvantages. Therefore, to develop CSFs may be wide-ranging and time- consuming. In addition developing appropriate documentation and reconciling opinions from different management levels may be difficult without prior under- standing of a project's functioning. There is also a process of education where the manager must be made aware of the importance of the critical success factors identified and the need to focus heavily on these factors.

BSP (Business Systems Planning)

The effectiveness of this method is dependent on the structure of an organization. Therefore, BSP is considered to be effective for firms in which the IT is more centralized and has a high impact on the firm (Frenzel, 1996).

It focuses on a business' key activities and the systems and data that support these activities. It is an iterative process that maps the data in the organization into its key activities. It is most usually applied within centralized environments where there is a tightly defined data architecture already existing.

Participants in a BSP methodology include the systems analyst and local managers as well as more senior managers. The systems analyst/information systems professional uses the plans that the managers have prepared for the IS system and develops a suitable BSP to support the strategic plan. A logical IS design is derived from the BSP and then more technical analysts are brought in to develop a physical data system design. The BSP is derived from strategic, operational and middle management perspectives. In its most detailed stages it may take far longer to develop a successful BSP than resulting CSFs. There is more of a focus on physical design rather than the actual information system, moulding the physical data to an information system. Decision making is based on three particular functions, planning, control and execution (Anthony, 1970). The actual process is an iterative one with continual modifications being made to the IS system. Figure 1 provides an overall conceptual model for the study.

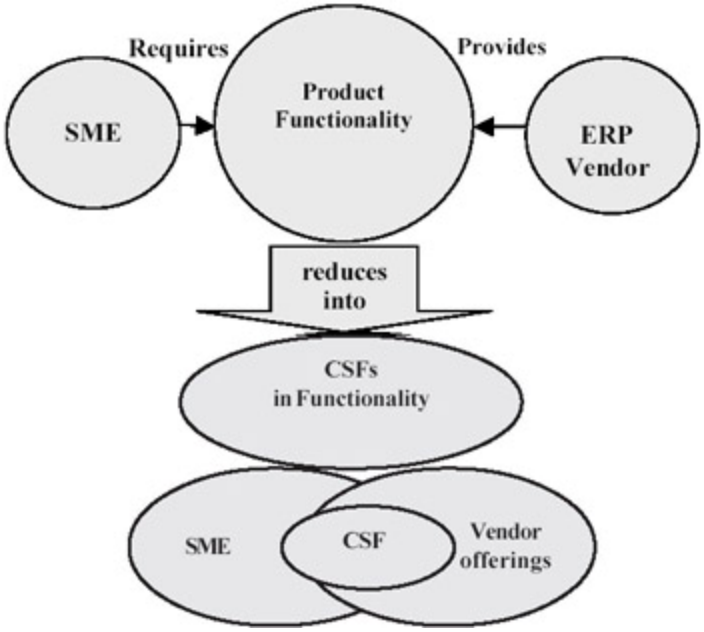

Figure 1: The conceptual model of the study

THE DESIGN OF THE STUDY

CSFs are developed from SME requirements and the vendors' offering of the ERP systems' functionality. In particular, the business functions form a part of the ERP system as a subset of those required or provided for larger enterprises. The methodological approach used here is a triangulation involving a combination of qualitative and quantitative methods. Interview and questionnaire are used in this study to collect data from the five vendors. Open- ended questions are used for the interview. The CSFs identified from the case investigated is used for the SWOT analysis to assess the functionality offered by the vendors. The steps for the research process are as follows:

1. Interviews with the SMEs and vendors to find six to eight key CSFs;
2. Combine results of Steps 1 and 2 to determine the key CSF to be used in the SWOT analysis;
3. Follow-up interviews with the vendors; and,
4. Construct the SWOT framework from the results of Step 4.

FINDINGS FROM THE CASES INVESTIGATED

The ERP market is like no other software market in Australia as there are a number of Australian software companies competing against major ERP vendors. Most recently the number of Australian ERP developers in the local market has been declining and more businesses especially, small-to-medium-sized enterprises (SMEs), are turning towards the leading overseas firms given their established client bases and their broad development and implementation skills. Imports from overseas countries make up approximately 55% of the Australian ERP market. The five major software vendors–SAP, Oracle, J.D. Edwards, Baan and PeopleSoft, are covered in this study.

SAP

The largest company in the ERP market is the German company SAP, controlling an estimated 30-35% of the local ERP vendor market and with an annual turnover of approximately US $93 million. It is estimated that about 50% of the company's revenues are generated from providing software solutions to the Australian manufacturing sector and is over twice as big as its nearest competitor. SAP's R/3 overcomes the limitations of traditional hierarchical and function- oriented structures. R/3 assists sales and materials planning, production planning, warehouse management, financial accounting, and human resources management and these are all integrated into a work flow of business events and processes across departments and functional areas. SAP's R/3 has no organizational or geographical boundaries; corporate headquarters, manufacturing plants, sales offices, and subsidiaries all merge for integrated management of business processes. SAP's ERP provides data analysis products called the Business Information Warehouse (BIW). Table 1 summarizes the SWOT findings for SAP.

Table 1: The SWOT of SAP

SWOT Criteria	Findings
Strengths	▪ SAP has the largest number of functional modules to choose from. Their modules cover a variety of 20 industries. Hence a wide range of expertise and highly adaptable solutions. ▪ SAP is developing what many consider to be post-ERP applications as add-ons to their existing applications. This includes CRM (customer relations management), which provides greater flexibility and fills the gap for a best of breed approach. ▪ They have the highest development and research budget of any of the ERP vendors. ▪ SAP is currently looking at outsourcing several Net-centric ERP implementations via mySAP.com. This allows the company to avoid technical maintenance and not have to rely on in-house skills.
Strength/ Weakness	▪ Providing total information management systems for enterprises. Linking all the disparate parts such as distribution, financials and networking branches and subsidiaries over a number of different platforms is also the company's weakness.
Weaknesses	▪ SAP's solutions do not provide solutions for all companies and claims that companies who provide more specialized solutions offer better value for money. ▪ SAP contracts are often delivered overtime and over-budget due to the difficulty in

Table 1: The SWOT of SAP

SWOT Criteria	Findings
	installing such complex systems in enterprises. ▪ SME's may feel besieged with the choice of modules and possible solutions. ▪ SAP has been slow to offer compact and more realistic solutions for SME's. ▪ Lack of existing focus towards SME's. ▪ 20% of needed functionality is usually missing from their packages.
Opportunities	▪ A trend towards e-commerce, Net-centric computing through implementations of XML, ASP, Java.
Threats	▪ Competing best of breed or more compact solutions that are more
Customers	▪ SAP's principal Australian clients include Ampol Lubricants, Australia Post, Mayne Nickless, Mobil Oil, Queensland Rail and Taronga Park Zoo.

Baan

The second biggest overseas vendor is the Dutch company Baan, which has approximately 6% of the local market. Similar to SAP, Baan has a strong manufacturing focus in the local market and aims to assist customers to achieve strategic business growth, improve business processes, and reduce operating complexity through the use of enterprise and Internet technologies. Their Microsoft-based e-commerce (E-Enterprise product) suits companies with less complex Web business needs and includes functions such as separate applications that help companies set up Web-based storefronts, online procurement, and product configuration.

Baan Supply Chain Solutions creates a responsive and interactive supply chain that makes businesses more efficient and therefore more profitable. Their system integrates from top floor to shop floor, site-to-site, enterprise-wide to assure consistency in strategic decisions, forecasts, plans, and schedules. Information is shared, business processes are automated and streamlined geographical. Baan's CRM automates the *sales and marketing processes,* providing higher quality sales, reducing the challenges faced by sales forces and aiming to deliver on-time. *Mass customization* aims to satisfy and predict a range of products and services to optimize customers' specific needs. *Customer-centricity* is used by Baan as a way of rethinking the way they interact with customers. They believe the Internet empowers customers to choose and that superior quality has become a competitive commodity. They see that in today's market, leaders identify and anticipate customer needs and offer consistently higher value-added products and services. *Baan's ERP financials* allows companies to rapidly access high-quality financial information, have strategic control of increasing margins, revenue and

cash flow and focus the financial team on planning and analyzing. Other tools include *strategic enterprise management*, which consists of financial analysis (Baan Business Intelligence Solution), financial consolidation (Hyperion Enterprise) and financial planning (Hyperion Pillar), and cost management, analysis and control costs on the basis of items manufactured, activities, business partners, number of order lines and much more. Table 2 summarizes the SWOT findings for Baan.

Table 2: The SWOT of Baan

SWOT Criteria	Findings
Strengths	▪ Baan's outsourcing of Web site assists midsize customers with ERP outsourcing decisions.
Weaknesses	▪ Risky financial position. ▪ Bann relies heavily on local partners in the form of consultants and systems integrators to provide implementation skills.
Opportunities	▪ Shift to e-commerce and focus on SMEs. ▪ Take-up of emerging technologies such as XML.
Threats	▪ A lack of market share and financial stability. ▪ Larger ERP competitors.
Customers	Baan's main clients include Deloitte and Touch's consulting arm ICS, which has announced that it recently had been chosen to support localized Baan components. Others include Western Power, Power New Zealand, Walker's Ltd. and Metal Manufactures Limited.

J.D. Edwards

US companies control approximately 32% of the local ERP market, and 3 out of 5 vendors in our study are American vendors and of them all J.D. Edwards has been the most successful at focusing attention on the SME market. The company generates approximately US $29 million in revenue from its Australian operations. They are the leading supplier of e-business solutions, aiming to deliver speed and quickness for customers throughout the world and providing innovative, flexible solutions essential in running complex and fast- moving multinational organizations. They also assist companies of small-to- medium sizes influence existing investments, take advantage of new technologies, and maintain competitive advantage.

OneWorld enables companies to facilitate online sales and services and supports their aggressive growth strategies. OneWorld gives greater usage of customer information and greater organization in day-to-day data, which better services towards J.D. Edward's clients. *E-Business, Supply Chain Management*–J.D. Edwards calls this *Collaborative commerce* (c-commerce), which enables to deliver it open, collaborative

technologies allowing *communication* among organizations, suppliers, and customers across the supply chain. It enables *streamlined and personalized business processes* between customers and suppliers and in addition provides Internet procurements to customers and employees. It also enables *synchronized planning and execution activities* for real time, as well as *reacting to constantly changing conditions* and *eliminates redundant supply chain processes*, thereby maximizing value in business-to-business environments and creating a shared network of commerce services.

Customer Relations Management–Aims to improve the customer life cycle– from identifying prospects and closing sales to order entry, fulfillment, service, and support. J.D. Edwards CRM aims to generate new business opportunities and revenue potential and also to extend the supply chain to customers.

Knowledge Management–Aims to capture all kinds of information and turn it into knowledge to make proactive decisions. Knowledge management seeks to capture information into categories so we are able to access to information to companies' advantage.

Procurement Solutions–This type of functionality optimizes business processes. For example companies are able to take advantage of pre-negotiated discounts with suppliers for expenses such as travel and resource purchases. In addition, it can reduce time-consuming phone and paper-based queries. Also this procurement solution enables calculation of valuable data such as cost benchmarking to make vital decisions.

Applications Service Provider–Brings a host application server where supply chains are actively linked and knowledge is exchanged in real time. ASP enables enhancement in customer relationships through technology. Also it enables goods and services to be easily procured online, and back-office functionality supports front-office visibility and enterprise management. Table 3 summarizes the SWOT findings for J.D. Edwards.

Table 3: The SWOT of J.D. Edwards

SWOT Criteria	Findings
Strengths	▪ J.D. Edward's products are very flexible since their participating outsourcers are competent with J.D. Edwards technology and can perform a significant part of installation of maintenance expertise in the ERP system. This reduces the possibility of in-house staff disagreements and ensures the selection, implementation and maintenance run more smoothly. ▪ J.D. Edwards' trend has been towards the e-commerce, e-business sides of ERP. It seems to be the leading vendor in this field. Currently it has over 1,000 B2B, e-commerce, and Web-enabled modules/applications. ▪ J.D. Edwards has good vendor support from Hewlett Packard, one of the main

Table 3: The SWOT of J.D. Edwards

SWOT Criteria	Findings
	hardware suppliers for ERP systems. ▪ J.D. Edwards does provide coexistence technology that allows old and new products to run together from common single database.
Weaknesses	▪ J.D. Edwards has narrow industry coverage when compared to a vendor like SAP. J.D. Edwards claims expertise in only HR/payroll, finance, manufacturing and distribution/logistics. ▪ Customers need to install the vendor's green screen applications on top of the OneWorld suite. ▪ OneWorld can use up network resources. ▪ J.D. Edwards cannot compete with SAP/Oracle in research and development.
Opportunities	▪ Combination of industry leading in B2B, e-commerce, e-business ▪ New technologies such as XML.
Threats	▪ Larger ERP competitors and financial insolvency.
Customers	▪ J.D. Edward's clients include Kenwood Trucks, Mack Trucks, Hunter Douglas and Yalumba Wines.

PeopleSoft

PeopleSoft is the largest of the US vendors and is placed second overall behind SAP with 9% of the local market (with annual revenue of approximately US $30 million). PeopleSoft targets mainly large-size companies for their products however, they have now also been focusing on the small-to-medium-sized market. Their products tend to address either business-specific processes or particular industry segments. PeopleSoft 8.0 has at least 59 collaborative applications that enable a business to combine transactions and go beyond their physical walls and help employees, customers, and suppliers work together. There are also another 108 core products, making it easy-to-use and the most technologically advanced enterprise application on the market.

PeopleSoft sees that portals are an excellent way to implement new e- commerce models by communicating with customers and suppliers via a Web interface. Their solutions are extendable and fully scalable. Information is easily accessed by users and targeted to the right people. PeopleSoft Portal Solutions enable staff to easily locate and

access relevant information from accounting, human resources to business intelligence applications. The supply chain management module includes SCP provides critical information on forecast demands based on previous information and input from employees, suppliers, and customers. Also in PeopleSoft's SCM, material management, streamlined processes to eliminate wasted time and be more cost effective. Manufacturing solutions, allows business- to-business collaboration, product life cycle management, and continuous quality improvement. With an open architecture the manufacturing platforms enable clients to adapt applications specific to their business (i.e., flexible and improves operational performance and increases customer satisfaction). PeopleSoft 8 CRM is the only CRM solution for enterprise relationship management from customer to employee to supplier. It enables one to encourage customer loyalty, maximize customer acquisition efforts and retain them for the long term.

Financials–Contains a family of financial applications with access to the Internet, giving customers, employees, and suppliers universal access to relevant information. Financial management automates and synchronizes the entire money- management chain of an enterprise. With the use of the Internet, data can be captured and processed to ensure that data can be analyzed in multiple ways to improve business decisions. Project management helps manage job resources across multiple sites, countries, and languages, can track materials and labor to stay on time and on budget and provides a view of project status to respond quickly when issues arise. Treasury management can control core treasury operations, meeting the changing business demands of international organizations. Table 4 summarizes the SWOT findings for PeopleSoft.

Table 4: The SWOT of PeopleSoft

SWOT Criteria	Findings
Strengths	▪ The company's real strength lies in providing payroll and human resource solutions to large Australian enterprises and government departments. ▪ Strong partnership ties with Hewlett Packard, Compaq, Microsoft and IBM. ▪ The fastest-growing ERP company over the past several years. ▪ High flexibility in outsourcing and external consultants trained in PeopleSoft technology. ▪ Wide variety of applications. ▪ Aggressive marketing programs including offering Baan customers $100,000 credit to switch to PeopleSoft and use their ERP systems.
Weaknesses	▪ Currently undefined strategy for e-commerece, B2B and in future directions of systems. ▪ Its manufacturing software has not been as

Table 4: The SWOT of PeopleSoft

SWOT Criteria	Findings
	yet readily embraced by Australia industry.
Opportunities	▪ Shift to e-commerce and SME focus. ▪ Take-up of emerging technologies such as XML. ▪ The buying out of Baan's as well as other ERP customers.
Threats	▪ Other vendors beating them to the punch in the SME, e-commerce and B2B market. ▪ In financial position, compared to Oracle or SAP.
Customers	▪ PeopleSoft's customers include Coles Myer, Western Australian Department of Education and John Fairfax Holdings.

Oracle

Oracle Systems Australia Ltd. is one of the largest companies supplying technological solutions for information management to business, industry and government in their region. Oracle Australasia has been in operation since 1985 and employs about 1,060 people in Australasia. In Australasia, Oracle provides over 10% of the financial management applications and is one of the first major software companies to supply software products over the Internet for developers and end users.
Oracle8i enables companies to build Internet know-how applications, which allows lower costs, can enhance customer and supplier interaction and provides global information access across platforms and across the enterprise. Oracle's e-commerce facilitates *customer loyalty*, collects customer information through the Internet, and enables access across all communications channels. It's also highly scalable, reliable and designed to handle the increase in transaction volumes as well as complex customer-support requirements. From *customer interaction* via the Internet, companies are more able to understand customer preferences and needs. Integrating with Oracle's e-commerce applications has an advantage of interacting with front- and back- office applications and allowing access to all channels to access customer feedback and improve business efficiency. It allows the collection of valuable customer information and uses it to create customer knowledge and targeted sales, marketing and other opportunities over the Internet or across customer communications channels. Oracle's Supply Chain consists of *order management*, which provides a link between CRM and ERP-enabling industries to build an end-to-end integrated enterprise. This link supports e-business from initial to prospect sales service and support as well as provides global access and facilitates instantaneous information exchange across the supply chain. Table 5 summarizes the SWOT findings for Oracle.

Table 5: The SWOT of Oracle

SWOT Criteria	Findings

Table 5: The SWOT of Oracle

SWOT Criteria	Findings
Strengths	▪ Oracle is the industry leader and specialist in financial applications. Many of these applications such as Oracle Financials were developed separately and are now being integrated into their ERP suite. ▪ Oracle has strong software support and compatibility with their dominance in large commercial databases. Hence this may make for a smoother all around package. ▪ Oracle, behind SAP, has the largest and most versatile range of ERP packages. ▪ Strong financial position. ▪ The vast majority of Oracle's ERP work is done in-house with staff being very familiar with the packages.
Weaknesses	▪ Lack of outsourcing or third-party consulting means a somewhat inflexible approach to implementation. ▪ Projects have been known to be delayed after staff poaching. ▪ A lack of versatile business partners. ▪ Inexperience of migrating large-scale ERP systems to SMEs and the current nonexistence of smaller, compact best of breed products. ▪ The perception of Oracle as a main player in the database arena rather than the ERP industry.
Opportunities	▪ Monopolise on database products to provide the most reliable and compatible all-around ERP systems. ▪ Shifting to B2B, e-commerce and e-business solutions for smaller companies.
Threats	▪ Smaller vendors monopolising on the SME territory. ▪ The disagreements between key members of the company with ERP
Customers	▪ Oracle's customers include Harley-Davidson, APC, Triton, ARCO Products, Kinetics Group.

CROSS-ANALYSIS OF THE CASES INVESTIGATED

An attempt has been made in the previous sections of this paper to provide SWOT functionality assessments of the five major ERP vendors offering ERP packages to Australian SMEs. Selection of an ERP system for SMEs in Australia depends largely on the compactness of the packages, flexible pricing, implementation methodologies, and functionalities. In terms of the functionality, although the majority of the modules cover the same areas, there is some distinction between each product.

Similarities/Differences

The five vendors that we have studied provide similar but distinct ERP software packages in term of functionality. All five products–R/3, Baan IV solution, OneWorld, Oracle 10.0 and PeopleSoft 8.0–provide basis modules to capture current and future needs of business requirements. Basic functions such as CRM, SCM, e-commerce, ASP, and financials are well-covered in each product. Here are some differences that should be noticed.

Modules: PeopleSoft offers limited manufacturing functionality, while Baan's software has limited human resource elements. SAP has a very broad set of features.

Internet solution: The latest release of Peoplesoft 8.0 provides a "pure internet solution" based on HTML and XML, making it easier for users to customize the application to meet their business needs. This new Internet architecture, abandoning the old client/server model so that no code should reside on the client, enables the user application access from any Web-enabled device. However, Oracle Web uses a Java-based architecture that requires Java on the client.

Package collaboration: J.D. Edwards is the only company that provides users with a way of collaborating with other enterprise packages to achieve a business objective.

Flexibility: SAP and J.D. Edwards provide the most flexibility to deal with the changing needs of an enterprise and to fill the gap for a best of breed approach.

Range of package: Oracle and SAP have the largest and most versatile range of ERP modules.
Expertise: SAP and Baan cover the same area of expertise, both concentrate on manufacturing knowledge, while Oracle specializes in financial applications, Peoplesoft in human resources and J.D. Ewards in construction and engineering.

ASP: SAP and J.D. Ewards use outsourcing from EDS to support its R/3 and Hewlett Packard for its OneWorld, respectively.

Common Factor Analysis

There are some common factors that the five vendors are tending toward. Vendors are targeting toward B2B e-commerce. All vendors are offering CRM except J.D. Edwards, who has developed a partnership with the world leader in CRM, Sieble, instead. Realizing the fact that implementation of ERP in SMEs is the future area of growth, all ERP vendors are fighting the perception of complexity to focus on SME customers. SAP, PeopleSoft, Oracle, and Baan all have made "substantial headway in developing bundled

packages and methodologies to reduce implementation cycles, which is crucial for success in that market segment," noted International Data Corp. in a recent ERP market report.

Implications of the Findings

"If implementation cost comes in lower we'll share it. If it comes in higher we eat it," said John Burke, senior vice president at SAP America. SAP claims to offer the cheapest ERP package for the mid-market in the world. It has the largest range of modules to be chosen and it covers 20 industries, which gives the customers the best fit to their business process. It is the most flexible ERP package offered in Australia. Due to the company experience in other areas, SAP has the highest development of new innovative products and highest expenditure on research out of all the five vendors. However, the wide range of modules without any existing focus on SMEs may confuse SMEs' strategic planning. It implies that SAP is more suitable for large companies who can afford the high implementation cost. SMEs looking for more specialized needs may consider other vendors.

Baan has a strong manufacturing focus that is similar to SAP. Baan IV is less complex and more directed to the individual needs of the organization. Baan was suffering from seven consecutive quarters of losses, and the lack of market share and financial stability make it difficult to compete with the others. J.D. Ewards has been the most successful at focusing attention on the SME market. The company spends great care in the service and implementation of the product. J.D. Ewards is particularly good in providing solutions for e-business and e-commerce. The major weakness of the company is the lack of research and development planning, which may cause future problems.

PeopleSoft has been hit hard financially with layoffs and management changes since early last year. The newest release of PeopleSoft 8.0 will be a critical point to the company. It transforms PeopleSoft 7.5 into a fully Internet-enabled application with a new browser-based user interface. Covering the basic modules from PeopleSoft 7.5, PeopleSoft 8.0 strives to share information more easily between different departments of the organization. Oracle is the worldwide leader in database sales and the industry leader specialist in financial applications. Oracle is also experienced in large and complex software development. The company holds a strong financial position. The wide range of modules it provides is just behind SAP.

Implications for Consultancy Group

ERP is a long-term investment for an organization that can afford the high cost and long implementation time. Successful investment in ERP requires a technical infrastructure with future growth designed to be a scalable, reliable computing environment with maximum availability, and throughput on a time-line suited to the ERP implementation schedule. The system should also be implemented quickly, efficiently, on time and on budget and with no interruption to the business. Consultation with professionals on project management and vendor selection is necessary. This is particularly true for SMEs since ERP vendors have a strategy to serve the large clients directly whilst directing SMEs to their resellers or consultants.

Consultants should understand the organization's current business processes, assess the impacts of integrating the system with different vendors and design a solution that will maximize the organization's current investment and minimize the transition process

within the time and budget of the organization. When the business requirements are well-understood, consultants should design a system environment that fits into the performance, capacity needs and business continuity plan. Hence, the consultants have to design the network with the vendor and perform capacity planning and recovery strategy, system management and operation procedures. The consultants also need to incorporate each component of the system into the organization's current IT environment and validate the newly integrated environment's functionality and performance.

Problem Concerning ERP

Although ERP strives to integrate all the major processes of an organization, certain customers still found that some essential functionality is lacking. Many complained that the objective of the system had not been delivered. ERP vendors are behind the time in providing the basic tools to connect their systems to Web applications in real time. It is not about simply putting Web access on the existing application. It's about bringing to the Web the advanced functionality of ERP systems broken into modular pieces, so that specific functions can be transferred to customers and partners on the Web within the internal back-end systems.

Oracle and SAP are the only two vendors who have started in this area, such as e-procurement and Net marketing. There are obviously technology issues with ERP online access. A lot of work still has to be done to get data from ERP and other enterprise systems integrated on a Web server. However, there will be an immediate problem of security when an ERP system goes online.

Implementing an enterprise resources planning (ERP) solution for SMEs can be a major challenge. It requires flexibility from both the client company and the consultants. ERP vendors still have a hard time installing systems and getting them to run right. Sometimes the target date for switching on an ERP system has become the ultimate goal, leaving aside the business goal that initially drove the decision to implement the ERP system.

The goal of ERP is to implement a system that supports the business. Vendors should avoid designing a system that the ERP system is capable of providing, but which is beyond the capability of the company to absorb as a routine part of the daily business. Implementation of ERP is often extremely complex; service of consultants is extremely important and is essential to a successful selection and management of ERP implementation.

CONCLUSION AND FUTURE DIRECTIONS

Within the Australian ERP market approximately 55% of the market consists of foreign competitors, and of these, five major software vendors are the focus of our study. These five vendors include SAP, Baan, J.D. Edwards, PeopleSoft and Oracle. SAP is the leading software vendor; they provide the largest number of functional modules, covering more than 20 industries, and have expert guidance to help with business transformation. They also have the highest research and development budget; however, due to their many different platforms, decision making can be confusing, especially for small-to-medium-sized businesses. It is often noted that SAP contracts are often overtime and over-budget. Baan has a strong manufacturing focus and they are shifting focus towards SMEs; however, they have a risky financial position and are in threat

from competitors like PeopleSoft in buying out their customers. J.D. Edwards is the only company providing their customers with the freedom to choose their internal and external applications and has good vendor support from well-known businesses such as Hewlett Packard. One of their weaknesses, however, is that they have a narrow industry coverage and inefficient research and development investment compared to competitors such as SAP. PeopleSoft supplies many large Australian corporations and government departments. They have a more general approach towards their ERP. Their disadvantage is that they have undefined strategies for their e- commerce B2B and in the future of their systems, and they are slow in getting a competitive advantage compared to their competitors.

Oracle is a leader and specializes in financial applications, with a strong software support and stable financial position. Their implementation however is somewhat inflexible and has been known to have delays. They also have a lack of versatile business partners and are seen as inexperienced in assisting with ERP systems for SMEs. It is widely understood that different industries and interests direct companies to choose which software vendor is best for their business. SAP, the leading ERP company, may not always provide the most appropriate ERP system, but with the amount of investment in research and development and the wide variety of modules with continuous expertise assistance, it is understandable that they are the leading ERP company of today.

A number of important technological, economic and legislative trends will come to bear on ERP systems, SMEs and their relationship in the future. SME needs will likely evolve with changing business models, best-practice models and competition. ERP packages offered by the vendors will move with technology and perhaps attain some maturity in implementation and general functionality. Consequently the alignment between these will change.

Above this rides the framework on which this report is structured. No matter what happens in the future, the CSF means of appraising the situation will remain vital to understanding the value of complex ERP systems. The list of CSFs developed in this report can be expanded to include new features and trends. It can serve as a history or catalogue of what ERP systems can do for SMEs. At any given time, a different subset of these CSFs may be the critical ones, the ones that make the most difference.

Future Research Directions

The emerging new economic models around B2B and B2C e-commerce will increase the importance of ERP systems being compliant with and connected to Internet marketplaces. Initiatives such as that taken by SAP with their R/3 and mySAP.com systems, bundling connection to the OneWorld marketplace, will likely prove very important.

The lack of skilled IT professionals and the need to train other employees to enable them to make use of the system will present a significant challenge. This problem is not unique to SMEs or ERP systems but is emerging from rapid technological evolution and the high costs of training. SMEs may find this issue particularly important given their smaller budgets.

The role of expert systems and in-built training will likely prove increasingly important, as will the need to avoid information overload and stagnation. The need to keep focused on the strategic value of ERP systems will become paramount in the face of

overwhelming decisions about which of the latest features to include. SMEs must stay focused on the return they are receiving from their IT investment in quantitative and qualitative terms.

A plethora of future avenues for research lie waiting in this area. There is a need to further qualify SME needs such as implementation strategies, on- board training, scope and size of system. There is also a need to examine exactly what each vendor is doing to tailor their systems to these SME requirements, particularly in the areas of complexity management, maintenance, B2B marketplaces and B2C support.

Valuable and relevant research could look at case studies within specific industries. This could reveal which vendor is best-suited to a given industry and how well each package customizes across industries. There is a need to look at how well each package scales with the company and how much room for diversification of business they leave or enable. Different implementation models could be examined. An appraisal, quantitative and qualitative, of the competitive advantage that ERP systems provide and a cost-benefit study to highlight which elements of functionality make the most revenue in which industry would be of enormous value to SME decision makers and vendor product engineers alike. What is perhaps most called for is a need for research grounded in case studies. There is an enormous number of largely theoretical aspects to be explored but the most valuable future research would reflect on what is happening in the ERP industry, marketplaces and real SMEs.

APPENDIX A: PRODUCT FUNCTIONALITY

Product Functionality	SAP	Baan	J.D. Edwards	PeopleSoft	Oracle
CRM (customer relations management) [1]	X	X	X	X	X
Single point of access for all customer records					
Order status from any point of customer contact			X	X	
Same information through multiple channels	X	X	X	X	X
SCM (supply chain management) [1]	X	X	X	X	X
Order tracking	X	X	X	X	X
Vertical integration			X		
E-business [1]	X	X	X	X	X
B2B, e-procurement	X	X	X	X	X
Marketplace links, alliances, membership	X	X	X	X	X
Standards, interoperability	X	X	X	X	X
E-tailing	X	X	X	X	X
Infrastructure for 24-7 operations	X	X	X	X	X
Security	X		X		X
Insurance					
Transaction models	X	X	X	X	
Integration of e-business and traditional means keep costs down	X	X	X	X	
ASP (application service provider), outsourcing [1]	X	X	X	X	X
Hosted system: e.g.,	X				

Product Functionality	SAP	Baan	J.D. Edwards	PeopleSoft	Oracle
mySAP.com					
Self-Service [1]		X	X		
Web-based customer access to order status, product support, sales information	X	X	X		X
Reporting [1]		X		X	
Internal: managerial					
External: business intelligence, shareholder, market information	X	X	X	X	X
Browser-based Web access [1]	X	X	X	X	X
Client, customer	X	X	X	X	X
Employee, internal–self-service, reporting		X	X	X	X
Work-flow automation [1]	X				
Business process reengineering				X	
Approval, routing and control automation					
Task orientation [1]	X	X	X	X	X
Support loosely structured activities: centring on single task rather than process (work flow)					
Business portals					
Alliances for content and functionality	X	X	X	X	X
EMU compliance–Standards [2]					
Multilingual support				X	
Triangulation [2]					
Training [2, 3]	X				

Product Functionality	SAP	Baan	J.D. Edwards	PeopleSoft	Oracle
Computer-based training	X	X	X	X	X
Documentation	X	X	X	X	X
Complexity [Unsourced]	X	X	X		X
Not overwhelm SME	X		X		
User interface					
Implementation times	X	X	X	X	X
Support required	X			X	
Skill level required in staff: use, maintain	X				X
No lock-in to single vendor [Unsourced]					
Interoperability					
Alliances, partnerships	X		X	X	
Standards compliance: e.g., ODBC					
Product dependence: e.g., Oracle database					X
Open system [Unsourced]		X	X		X
Evolve with organization and environment	X	X	X		
Technologically: interoperability	X	X	X		
Economic model: B2B, e-tailing, taxation, regulation	X	X	X	X	X
Modularity					
Suitability [Unsourced]	X	X	X		X

Product Functionality	SAP	Baan	J.D. Edwards	PeopleSoft	Oracle
Management style					
Level of formality and structure					
Best practices	X				X
Geographic distribution [Unsourced]	X	X			
Support regional offices	X	X	X	X	X
Remote access (Web)	X	X	X	X	X
Regional differences					
Specific functionality [Unsourced]	X	X	X	X	X
Data mining					
Data warehousing	X		X		
Expert systems: AI, training	X		X	X	
Decision support	X	X	X		
Best-of-Breed	X	X	X		X
Implementation strategy [Unsourced]	X	X	X		X
Quality of vendor [Unsourced]	X		X		X
Expertise, history	X		X	X	X
SME focus	X	X	X	X	X
share, competition, stability	X				X

APPENDIX B: CANDIDATE CSF

The following is a list of factors or dimensions that could be used to evaluate the functionality of an ERP system offered to an Australian SME. From this list, 6- 8 critical success factors (CSF) will be chosen based on criteria to be determined at a later stage of this project.

Each factor is listed by the name we have given it, followed by references that support its inclusion in this list and then attributes that could be used to measure its presence or "magnitude" in any particular ERP implementation.

CRM (customer relations management) [1]

- Single point of access for all customer records
- Order status from any point of customer contact
- Same information through multiple channels

SCM (supply chain management) [1]

- Order tracking
- Vertical integration

E-business [1]

- B2B, e-procurement
- Marketplace links, alliances, membership
- Standards, interoperability
- E-tailing
- Infrastructure for 24-7 operations
- Security
- Insurance
- Transaction models
- Integration of e-business and traditional means keep costs down
- **ASP (application service provider), outsourcing** [1]
- Hosted system: e.g., mySAP.com
- **Self-Service** [1]
- Web-based customer access to order status, product support, sales information

Reporting [1]

- Internal: managerial
- External: business intelligence, shareholder, market information

Browser based Web access [1]

- Client, customer
- Employee, internal–self-service, reporting

Work-flow automation [1]

- Business process reengineering
- Approval, routing and control automation

Task orientation [1]

- Support loosely structured activities: centring on single task rather than process (work flow)
- Business portals

- Alliances for content and functionality

EMU compliance–Standards [2]

- Multilingual support

Triangulation [2]

Training [2, 3]

- Computer-based training
- Documentation

Complexity [Unsourced]

- Not overwhelm SME
- User interface
- Implementation times
- Support required
- Skill level required in staff: use, maintain **No lock-in to single vendor** [Unsourced]
- Interoperability
- Alliances, partnerships
- Standards compliance: e.g., ODBC
- Product dependence: e.g., Oracle database

Open system [Unsourced]

- Evolve with organization and environment
- Technologically: interoperability
- Economic model: B2B, e-tailing, taxation, regulation
- Modularity

Suitability [Unsourced]

- Management style
- Level of formality and structure
- Best practices

Geographic distribution [Unsourced]

- Support regional offices
- Remote access (Web)
- Regional differences

Specific functionality [Unsourced]

- Data mining
- Data warehousing
- Expert systems: AI, training
- Decision support
- Best-of-Breed

Implementation strategy [Unsourced]

Quality of vendor [Unsourced]

- Expertise, history
- SME focus
- Financial position: market share, competition, stability

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Chapter XI: Selecting and Implementing an ERP System at Alimentos Peru

OVERVIEW

[1] All individual names, company names, and brand names have been disguised.

J. Martin Santana, Jaime Serida-Nishimura, Eddie Morris-Abarca and Ricardo Diaz-Baron
ESAN, Peru

The case describes the implementation process of an ERP (enterprise resource planning) system at Alimentos Peru, one of the largest foods manufacturing companies in Peru. It discusses the organization's major concerns during the mid- 1990s, including increasing competition, inefficiency of business processes, and lack of timely and accurate information.

To address these concerns Alimentos Peru launched several projects, one of which involved the implementation of an ERP system. The case explains the criteria used to evaluate and select the system, as well as the main issues and problems that arose during the implementation process. More specifically, the case focuses upon a set of implementation factors, such as top management support, user participation, and project management.

Finally, the case concludes with a discussion of the benefits obtained from the introduction of the system as well as the new organizational challenges.

BACKGROUND

Alimentos Peru manufactures and sells food products for direct or indirect human consumption including cookies, nonalcoholic beverages, bakery products, and sweets, yeast and other ingredients for bread making. It is a subsidiary of International Food Group (IFG), one of the world's largest food products manufacturers and sellers. In Peru, its leading brands are Turtora, Real, Tako and Remo.
IFG has been present in the Peruvian market since 1939, with the opening of its subsidiary Real Peruana Inc. In 1993, as part of a number of mergers and acquisitions of food producers in Latin America, *IFG* bought the Estrella S.A. cookie maker, the then leader in the Peruvian market. The merger of the Peruvian subsidiaries started operating as *Alimentos Peru.*

Alimentos Peru has two production plants. The first one is located in Lima and concentrates on cookie and candy manufacturing. The other is located in Callao and is devoted to producing inputs for bread making and powder drinks.

Alimentos Peru has faced a long fall in demand as well as intense local and foreign competition. Its executives were aware that their success hinged on introducing a comprehensive strategy that would comprise satisfying the consumers' expectations and needs, as well as reducing operating costs. By the mid-1990s, the company

introduced new manufacturing techniques and launched a number of projects to formalize, restructure and standardize its processes.

Its leading production line is cookie making, the source of the company's largest (45%) share of profits. Until 1994, the cookie market was rather dull and led by local brands. However, in 1995, substantial changes started to occur. The acquisition of *Molinos* by the *Atlantic* consortium and the arrival of a new competitor–Chilex, a Chilean company–introduced a new dynamic to the market. Furthermore, imported cookies started to arrive from abroad including those distributed by *Alimentos Peru*, *Orval*, *Rose* and *Crasp*. Imported cookies increased their share of the local market from 2% to 10%.

To face the new competitive environment, *Alimentos Peru* changed the packaging in most of its *Estrella* products to make them more attractive and improve their preservation. It introduced new products, including *Chocosonrisa* and *Marquinos*, as well as a new line of imported cookies that are leaders in the international market. Blanca Quino, head of product lines at *Alimentos Peru*, told a local publication: "*We have introduced innovations in our line products at least once a year*. *Now the winners will be those who can introduce more innovations in a market where the consumer makes the final decision*."

In 1996, *Alimentos Peru's* share in the cookie market exceeded 30% and its *Estrella* brand name remained as the local leader with 23% market share. However, the consortium *Atlantic* reached the same market share after buying *Molinos*, manufacturer of *Gloria, Zas* and *Ducal*. Moreover, although aimed at a different market segment, *Empresa Galletera*, through its *Grano* and *Pepis* brandnames, covered over 21% of the market. This firm's strategy was to sell cookies at a lower price than its competitors.

The beverages and desserts market, a line that creates 29% of *Alimentos Peru's* revenues, also suffered changes due to international competition. The company upgraded the packaging of its *Tako* line of drink powders to meet consumer preferences and introduced a larger variety of flavors. *Remo* beverages went through a number of innovations including a new range of flavors and a ready- to-drink line of products launched at the end of 1995.

In 1996, *ASPA Alimentos* was the market leader for powder beverages with a 53% share at company level, followed by *Alimentos Peru* with 37.1%. *Tako–Alimentos Peru's* brand name–was the leader in the sugarless beverages market segment with 19% of the market. It further benefited from the growth in the sugarless market segment. Growing consumer preference for sugarless products sold at a lower price strengthened *Tako's* position against the semisweet *Kino* and *Bingo* products from *ASPA Alimentos*. In the sweet products segments, *Alimentos Peru's Remo* held strong to its 62% market share but faced strong competition from other brands, including locally produced *Dinang* and *Fructal*, a Chilean import.

In its other product lines–bread-making ingredients, candies and chocolates– Alimentos Peru rose to the challenges in a similar manner by introducing new products and changing its packaging, and by improving on its distribution system.

Appendix A shows the financial statements of the company for the period between 1994 and 1998.

SETTING THE STAGE

Information Systems

After the merger of the Peruvian subsidiaries, the information technologies divisions at Alimentos Peru's Lima and Callao factories merged under one single manager. Carlos Montero became the systems manager in 1994 and was the second person in charge in this area after the merger of *IFG's* Peruvian subsidiaries. Montero's main challenge was to put in place a new information system for the company to replace old systems that were typically fragmented, duplicate and inconsistent. At that time, the new IT division employed 19 persons, mostly programmers, and reported to the local financial manager: *"This was a typical data processing division in the 1960s style,"* says Montero.

The company had two AS/400 IBM servers–one at each facility–that operated at about 80% capacity. Each was connected to about 50 terminals and PCs of varying age and brand names, all operating independently. Each factory ran its own IT systems to suit its peculiar needs. There were more than 20 independent systems, including two parallel systems to process purchases, another two to keep warehouse records, another two for manufacturing, another two for cost and finished product control, and two more for marketing. Furthermore, there were five systems for payrolls: two for laborers, two for clerical workers and one for staff. Lotus 123 and WordPerfect were the standard office software products. The main task at the IT division was maintenance.

Likewise, each plant imposed its own criteria when giving code numbers to their ingredients and finished products. Furthermore, some areas within the same plant, for instance, warehousing or manufacturing, would use different code for the same finished product. In Lima, costing was based on the number of work hours while in Callao it depended on product weight.

Little integration of operations also had an impact on the financial system. Closing of accounts at the end of each month would take more than one week, despite long working hours (overtime) put in by employees. Cost controls were hard to implement as was determining which products were actually yielding a profit. Management reports were put together manually and then sent to *IFG's* offices in the US The first integrated accounting system was introduced in January 1995 thanks to an in-house development. By that time, the IT division had shrunk to seven people after outsourcing programming tasks.

Although both factories were already under one single company, both plants continued to operate separately and their operations showed the same lack of integration that was apparent in their information systems. Not one business process operated under a standardized model, not even account closing at month's end, inventory control or purchasing, or in general any of hundreds of activities in the production process. About this issue, Carlos Montero holds:

"Personnel were not used to filling in forms, recording data or examining the manufacturing formulas (or recipes). Inputs requisitions for manufacturing were sent casually: Approximate amounts of ingredients were sent to production and leftovers were returned to warehouse. This led to a large amount of shrinkage and prevented keeping good records on production costs."

Alimentos Peru Strategic Initiatives

By the mid-1990s, the company designed its corporate strategic plan. The general manager, functional managers and the company's main executives met to determine the company's mission and vision, analyze their competitive environment and determine the main strategic actions to take. As a consequence, a number of projects were proposed and assigned to various company executives. The following main strategic actions were introduced:

- To conclude with the corporate merger, led by Tanya Santisteban, the administration and finance manager.
- To develop new products and reorganize the sales force and distribution channels.

This task was assigned to Armando Linares, the marketing manager.

- To introduce total quality at *Alimentos Peru*, in charge of Mario Neyra, the human resources head.
- To train personnel in MRP II techniques, commissioned to Jorge Figueroa, the logistics manager.
- To improve and integrate information systems, a responsibility assigned to Carlos Montero, the systems manager.

After merging the financial and administration, the systems, and the logistics divisions in 1994, in the years that followed the company continued to merge its other areas. By year-end 1995, plant management in Lima and Callao was placed under a single manufacturing manager office. A few months later, the marketing managers' offices came under a single marketing division.

A Quality Committee was set up, headed by the human resources head and including various task forces for each area: logistics, manufacturing plants, internal and final user physical distribution. The purpose of this setup was to identify and propose ways to improve processes through Quality Circles that remained in operation until the end of 1997.

In 1995, the general manager hired Oliver Wight LLC, an international consulting firm that had created the MRP II techniques and a training specialist to prepare and put in practice a personnel-training program. Training was mainly directed at manufacturing, logistics and marketing personnel, initially through talks and in 1996 with video screenings.

Also in 1996, to improve product distribution and response to customer demands, *Alimentos Peru* restructured its sales force. From a geographically based system, it moved to a client-type system. The new system was put in place in coordination with local supermarket chains and allowed the company to cut operating costs and to increase compliance with purchase orders from these channels.

Jorge Figueroa makes the following comments about this stage in the company's evolution:
"IFG put strong outside pressure on the general manager. Alimentos Peru's personnel saw its workload increase substantially when a series of projects were introduced

simultaneously. The projects were implemented through work teams *but individuals put a priority on the team headed by their immediate boss."*

In 1997, *IFG* decided to centralize production, supply and distribution operations at its subsidiaries around the world on a regional basis, with a view at establishing "business regions" that would profit from relative advantages in each country. *Alimentos Peru* and the Ecuador, Colombia and Venezuela subsidiaries came under a single production and marketing unit. Venezuela was chosen to become the central management seat for the Andean area.

As a result of the above, the company adopted a new organizational setup. Marketing split into marketing and sales and all other managers' offices, including IT, started to report to the corresponding corporate manager in Venezuela.

CASE DESCRIPTION

A Project To Introduce an ERP System

The aforementioned challenges and problems as well as management's need to get timely and reliable information prompted the project to improve the company's information systems. In this respect, Montero holds: *"At meetings between the general manager and line managers, frequent comments were 'We don't have timely information' or 'Information is very expensive.'"*

With support from local consulting firm MISPlan, at the beginning of 1995 Carlos Montero prepared an evaluation of the company's information systems. Based on this evaluation, Montero formulated the following recommendations to the general manager (see Appendix B):

[2] Carlos Montero was away from *Alimentos Peru* from mid-1995 until the beginning of 1996.

- To introduce client server systems.
- To assess the capability and quality of the central servers.
- To standardize office software.
- To evaluate the IT manager's office structure.
- To introduce an enterprise resource planning (ERP) system for integrated corporate information management.

The question whether *Alimentos Peru* should get its software off-the-shelf or write it in-house was quickly answered. Necessary software functional requirements, the capacity to integrate with other *IFG* subsidiaries and the time for introduction warranted getting an off-the-shelf software product. Marcela Burga, IT development manager, holds:

"We evaluated the option to develop our own software and estimated a 2-year period for implementation, slightly longer than would be needed to implement a commercial package. Moreover, an in-house software would not provide the breadth and scope of functions that could be expected from a commercial package."

On this same decision, Jorge Figueroa says:

"In-house development would have required an extraordinary amount of attention from our people, both for design and implementation. On the other hand, this would be custom- made software. At that point in time we did not know if what we had actually suited our processes. Furthermore, using offthe-shelf products would make integration with other IFG subsidiaries easier."

The project to implement the new information system started with software selection. Evaluation of the ERP system started in November 1995 by putting together a task force organized as follows:

- Steering Committee, made up by the area managers and headed by Jorge Figueroa.
- Manufacturing and Logistic Function Committee.
- Marketing and Financial Function Committee.
- Technical Committee, made up by systems division personnel.

Choosing the ERP system and identifying the corresponding implementation strategies was coordinated with *IFG*, whose systems development policy gave its subsidiaries freedom to make their own decisions. There was prior experience of systems introductions in other subsidiaries:

- Ecuador: BPCS for the logistics and manufacturing areas.
- Venezuela: BPCS for the logistics, manufacturing and distribution areas.
- Argentina: BPCS for the distribution and financial areas, and PRISM for the manufacturing area.
- Canada: PRISM for the logistics and manufacturing areas.
- Puerto Rico: J.D. Edwards for the financial and distribution areas.

ERP systems evaluation at *Alimentos Peru* went through two stages. In the first stage, four ERP systems were evaluated: BPCS, J.D. Edwards, PRISM and SAP R/3. The evaluation was based on the following criteria:

- To provide a comprehensive solution including modules that could be enforced within all business processes within the company.
- To have a track record at *IFG*.
- To have a local representative in Peru.
- To propose versions for the AS/400 platform.
- To allow work in a client-server architecture.

In this stage, implementation costs and time were almost totally disregarded. A quick decision was made because Peruvian software suppliers were not numerous and had little experience. J.D. Edwards software had no local representative and included only the financial module. SAP R/3 did not have a local representative either nor were there

any experiences of using this system at *IFG*. Taking these considerations into account, BPCS and PRISM were prequalified and went on to the next selection stage. Results from the first evaluation stage appear in Table 1.

Table 1: Results of the first evaluation of an ERP system

ERP	Comprehensive Solution	Previous Implementation at IFG	Local Representative	AS/400 Compatibility	Client-Architecture server
BPCS	ü	ü	ü	ü	ü
SAP R/3	ü	x	x	x	ü
PRISM	ü	ü	ü	ü	ü
J.D. Edwards	x	ü	x	ü	x

As a next step, the task force devoted itself to determining whether either BPCS or PRISM met the company's needs.

First, they evaluated the software supplier and its local representative. The Steering Committee studied the organizations, local facilities and technical support both in Peru and outside. The shareholding structure of the local representative, experience in prior implementations, customers and additional products and services offered were other factors taken into consideration. During visits with local representatives, they were asked to make presentations about their ERP systems and their organizations. Finally, references from clients with previous implementations were checked. *Alimentos Peru* IT personnel visited other subsidiaries where the selected ERP software had already been installed and examined the contingencies that emerged during the implementation stage and verified the systems' functionality, transaction processing times and the volume they could support.

Local representatives of each ERP system made presentations before the Function Committees, who also reviewed the corresponding handbooks and demonstration versions. The functionality of each system module was compared with the functionality needed for the business processes by assigning a percent score to reflect the matching degree between the proposed software and the desired business processes. All the committees gave BPCS a higher percent score than PRISM.

To evaluate the software's stability, IT personnel resorted to version evolution over time. They also evaluated other aspects, including the working platform, programming language, type of database and handbook language. Cost analysis included the initial investment required, implementation costs, and annual fees for support and software updating.

This second stage took 3 months, most of the time for evaluation. At the end of this time, the Steering Committee chose BPCS. The decision was favored by the system's previous implementations at *IFG* subsidiaries and the longer experience offered by the consultant, locally represented by XSoft, charged with the implementation.

Results were reported to *IFG* US headquarters in April 1996. James Robinson, general information systems manager for *IFG*, came to Peru to bring the approval for the BPCS system as the ERP system to be implemented at *Alimentos Peru*. To conclude with the selection process, the following task was to design an implementation strategy and to start negotiations with the consultant.
[3] After finishing the ERP system selection process and internal restructuring, the company's IT manager started reporting directly to the local general manager.

The BPCS system would be implemented in the purchasing and ware- housing, manufacturing, cost control, accounting and treasury, and marketing divisions, thus fully integrating *Alimentos Peru's* operations. Carlos Montero had estimated this process would take 18 months and involve about 80 persons, including consultants (both to redesign the processes and ERP software specialists), IT personnel and users.

The project's total estimated budget reached US $800,000, of which US $450,000 would go to software licenses and US $350,000 to hardware acquisitions, implementation, consultancy and training. Taking into consideration that other subsidiaries had experienced cost overruns due to contingencies during the implementation period, Montero felt that the time and cost estimates were too optimistic and wondered what factors would facilitate successfully implementing the new system.

The initial discrepancies between software functionality and the business processes then in place had already surfaced in the evaluation stage. In this regard, Marcela Burga, a member of the Steering Committee, holds:

"The accounts payable module involved the accounting and treasury divisions. The BPCS software suppressed two functions in accounting and added one to treasury. The head of the treasury division was not willing to take up that function.
Despite the fact that the process as a whole was more simple, we saw things as divisions rather than processes."

Towards the end of June 1996, right after the implementation had been launched, the most experienced consultant assigned by the firm left the project. A much less experienced replacement came in and Montero thought IT personnel involvement would become critical in understanding the new project's functionality and ultimate success.

The implementation strategy and methodology were determined in coordination with XSoft, the implementation consulting company that was also the local representative of SSA Inc., the vendor of BPCS.

Three implementation stages or subprojects were devised to be introduced sequentially. The initial subproject would comprise the logistics, purchasing and warehousing, and manufacturing and cost control modules. The second subproject included accounting, and the third one was for marketing.

Montero thought the members on the task force should exhibit a range of qualities, most importantly their capacity to manage a project, experience in information systems implementation, knowledge of business processes, and capacity to lead change.

To lead the project, there would be a Steering Committee, comprising the respective area managers, charged with identifying business processes and the implementation strategy. To line up the ERP system implementation and the MRP II training program,

Jorge Figueroa was named project leader with Marcela Burga as general coordinator. Burga was also systems development manager and Montero's deputy.

User personnel were chosen to make up the work teams. Each team would include a maximum of seven or eight members, with a leader chosen among them who would be further supported by a member from the IT division. A total of 75 persons would take part in the project's 10 working teams. Personnel selection and working team configuration took place following recommendations issued by each area's manager. The candidates were expected to meet the following requirements:

- To be outstanding members in their divisions.
- To show a participatory and proactive attitude.
- To be capable of using the system and possess a research-oriented attitude.
- To know the process well.
- To be innovative (although in many cases innovations would be the responsibility of IT personnel).
- To have decision-making capacity within their own divisions.
- To be open to communication and have direct contact with their immediate superiors.

Table 2 shows the implementation methodology recommended by the system's supplier.

Table 2: Implementation methodology for an ERP system

Activity	Participants	Description
Documenting original processes	▪ Implementation teams ▪ Organization and methods specialist (one person) ▪ Implementation consultant ▪ IT division	Define business processes. Evaluate each process scenario. For instance: in purchasing: inputs, spare parts, fixed assets, sundries; in inventory flow: purchases, transfers, and loans. Process formalization: process, procedures, rules and policy documentation.
Training in process reengineering	▪ Oliver Wight consulting ▪ firm ▪ Implementation consultant ▪ Implementation team ▪ IT division	MRPII training program with an emphasis on "formula accuracy" and "inventory accuracy" as critical elements to link the implementation of the sales plan, production planning and materials requisitions

Table 2: Implementation methodology for an ERP system

Activity	Participants	Description
Training in ERP system use	▪ Implementation consultant ▪ Implementation team ▪ IT division	Demonstration versions and handbooks. Training of implementation team leaders. Training of implementation teams by their leaders.
Process remodeling	▪ Implementation consultant ▪ Implementation team ▪ IT division	Identify business processes prototypes with users. Identify divergences between functionality of the ERP system and business processes.
System trial runs	▪ Implementation consultant ▪ Organization and methods specialist (one person) ▪ Implementation team	Selecting real data to test each module. Stand-alone module testing. Interconnected module testing. Parallel trials using original systems and new modules.

Implementing the ERP

As mentioned previously, the implementation stage started with the logistics and manufacturing modules in June 1996.

With the ERP system implementation underway, *Alimentos Peru* started to enhance its hardware and software platforms. Both IBM AS/400 servers were upgraded, increasing their speed and storage capacity. The two factories were connected through a client-server network. One of the AS/400 servers was used as a production server and the other as development server. New personal computers were installed while some old ones were upgraded. The company installed a Windows operating system to be used as the computer network software platform. MS Office was used as office software. Lastly, MS Exchange provided electronic mail capabilities for both internal interconnection and connection with other *IFG* subsidiaries. All of these tasks, including user training, took about 6 months.

The ERP system implementation teams were configured at head and super- visor levels. Jorge Figueroa's participation as project leader allowed the logistics division to make timely decisions because lack of decision-making capacity was slowing down the project in some processes. During implementation of the manufacturing modules, for instance, there was a step back when the area manager did not directly approve a process change. Regarding the involvement of user division personnel: *"Corporate changes led to high personnel turnover and rightsizing. Some key elements in the ERP system implementation project were replaced by others who had to get new training."*

Implementing the system required appropriate documenting and recording of each and every purchasing process and stock movement. Montero and Burga realized that best business practices and formalizing people's work would attract division managers' interest as well as attention from the general manager.

Jorge Figueroa, the company's logistics head, says:

"When we started implementation, nobody respected the time periods. We had no idea how big an ERP system implementation project would be because there were no previous experiences in Peru. As the implementation moved on, management gained a better understanding of the project's scope and size, leading to a change in mind-set. So we were able to make better decisions."

Since the very beginning, the implementation team had to face the difficulties stemming from divergences between the ERP system functionality and business processes. Although the ERP system had been designed as a standard application that does not require significant changes for specific users, the system needed configuration so it could be adapted to each process's individual requirements.
Configuring a system requires much attention and experience. A single change in a configuration table has a substantial impact on the way the ERP system will operate. At *Alimentos Peru*, configuring the ERP system followed the process models prepared by each user division.
About the differences between the ERP functionality and *Alimentos Peru's* business processes, Marcela Burga holds:

"Together with the accounts payable module rejected by treasury, we also returned the cost control module. According to users, the cost data supplied by the module did not provide the depth of detail required by IFG. Systems must not only be good; users must also accept them. We had to develop these modules independently and design interfaces with BPCS, thus delaying the implementation process."

Jorge Figueroa adds:

"The main implementation issues arose when the ERP system functionality failed to match the processes. When we evaluated the ERP system the consultant told us that the system had the capacity to do whatever we required from it but later we found some surprises."

Carlos Montero remarks:

"The guiding principle during implementation was not to modify the ERP system."

Implementing the logistics and manufacturing modules took until May 1998. The last 3 months were devoted to final user training, in particular factory workers, and to trial runs. Their own bosses trained personnel. Bosses would get their people together and prepare an explanation talk with support from IT personnel.

The final trials included a 3-week test running the original systems and the new system in parallel. According to project participants, this was the best way to teach future users how to use this tool.

Marcela Burga has the following comments about the final stage:

"Immediately before launching our manufacturing and logistics modules, we found out about difficulties in other countries with the system's start up, and general management asked us to take every possible precaution. However, our personnel felt they were ready. When we started the system, we found only very small errors."

Implementation of the accounting modules started in October 1998 and lasted 3 months. The sales and marketing modules took 4 months, starting in January 1999. Youth, a proactive attitude and a greater decision-making capacity among personnel in these divisions led to a fast implementation.
By that time, Montero had realized that implementing the ERP system had effectively introduced changes in *Alimentos Peru's* business practices that would have a positive impact on the company's
financial position. Some of the changes were the following:

- Availability of consistent information that suppresses the need for manual integration and reviews that were at the source of many human mistakes and were time-consuming. With the new system, company managers had access to a consistent and single version of the data.
- Standardization and simplification: The company started to use a single language. Materials could be identified in a single way throughout the company and criteria for the various activities were likewise unified.
- Formalization of operations: Before introducing the system it was usual to ask and use materials without the corresponding purchase order, as was sending raw materials to warehouses without using standardized and updated forms. When the new information system and the MRP II concept were introduced, personnel were obliged to fill in forms and check the data for each operation. *"From the very beginning of the implementation, bosses were called at home, even late at night, to ask authorization to close manufacturing orders needed to close accounts. Everybody had to get used to operating formally*," says Marcela Burga. The period for closing accounts at the end of every month diminished from more than 1 week to just 2 days without any need for the people to work overtime.
- Better business processes: Sales and manufacturing programming depended on end-of-month stocks. This practice led to piling up of finished product and raw materials stocks in warehouses so that orders could be filled at the end of the month. New ideas introduced by MRP II and using the ERP system allowed for operations to be spread out homogeneously throughout the month. Two new positions were created thanks to the new information system: a demand manager and the master production planner.

CURRENT CHALLENGES AT ALIMENTOS PERU

The implementation of the ERP system at *Alimentos Peru* ended in April 1999. A few months later, while he is on his way to work, Carlos Montero thinks about new user requirements. He thinks about the most valuable aspects of this experience and the learning process the company went through while implementing the new information system.

Looking back at the process, Montero remembers the tough decisions that were needed and the many sleepless hours needed to implement the system and redesign the

business along a road full of switchbacks. He says: *"What did we learn? How could we have reduced total implementation time? What can help us in future implementations?"*

Montero is aware that there is a new role for the IT manager. *"More than programmers and operators, we are now systems analysts and we have to support users to continuously improve their business processes,"* he adds.

Now *Alimentos Peru* has the ERP system as a foundation for its transactions. The company, however, has new requirements. Some of the technologies under evaluation as part of the new technology plan are the following:

- Data warehousing and business intelligence tools to support the marketing user division in sales planning. In this regard, Montero wonders, *"Shall we have the analysis capabilities to use these new types of tools? Will we be able to use them well and benefit from these new tools? Will anyone arrive at any conclusions using the data provided?"*
- Interorganizational information systems that would provide an EDI interconnection with the company's main customers to enhance supply operations. Montero thinks that any EDI change must go hand in hand with a change in mind-set among salespeople. *"The salesperson will no longer need to provide plenty of information or long price catalogs. They will devote themselves to sell."*

APPENDIX A: FINANCIAL STATEMENTS

BALANCE SHEET (In thousands of U.S. dollars)

	1.994	1.995	1.996	1.997	1.998
Current assets	10.241	14.133	16.136	19.273	17.023
Non current assets	13.064	13.724	15.172	21.197	20.200
TOTAL ASSETS	23.305	27.857	31.308	40.470	37.223
Non current liabilities					
Current liabilities	9.615	14.648	14.673	21.647	20.119
	2.770	1.532	767	0	
TOTAL LIABILITIES	12.385	16.180	15.440	21.647	20.119
Shareholders' equity	10.920	11.677	15.868	18.823	17.104
TOTAL ASSETS AND LIABILITIES	23.305	27.857	31.308	40.470	37.223

P/L STATEMENT (In thousands of U.S. dollars)

	1.994	1.995	1.996	1.997	1.998
NET SALES	48.439	54.318	60.658	63.056	61.865
COSTS AND EXPENSES					
Cost of sales	32.208	37.162	38.823	40.114	41451
Sales expenses	6.869	9.472	11.724	13.584	14.086
Overhead	5.370	4.990	4.160	3.443	3.142
Total	44.447	51.624	54.707	57.141	58.679
RESULTS FROM OPERATIONS	3.992	2.694	5.951	5.915	3186
OTHER REVENUES (EXPENSES)					
Financial revenues	119	109	138	162	161
Financial expenses	-1.505	-1.376	-1.216	-1076	-1.062
Other, net	-25	47	-170	-353	8
Results from exposure to inflation	714	154	54	-30	-1.708
Total	-615	-1.066	-1.194	-1.298	-2.601
PROFITS BEFORE PARTICIPATIONS	3.377	1.628	4.757	4.617	585
Participations				-574	-154
Income tax	-372	-436	-841	-1.550	-415
Total	-372	-436	-841	-2.124	-569
NET PROFIT	3.005	1.192	3.916	2.493	16

APPENDIX B: INFORMATION SYSTEMS EVALUATION AND RECOMMENDATIONS

Executive Summary

Current Situation

The current information systems include both those originally developed for Real Peruana Inc. and those for Estrella S.A. These systems are still being used in Alimentos Peru.

Since the merger in 1993, there has not been any major development/update effort that would improve the systems. As a result, they do not effectively support the current organizational business processes. The major problems with the information systems include:

1. Lack of timely and reliable information.
2. Lack of integration among existing systems.
3. Duplicate systems for a number of functions.
4. Lack of flexibility. Most of the current systems were designed following rigid structures that do not allow the IT staff to easily update the systems. When they were designed, no appropriate programming tools were available.
5. Lack of system documentation.
6. The IT division is mainly concerned with maintaining existing systems; there is not enough time for new developments.
7. In accounting, finance and sales divisions, information has to be handled or consolidated using special programs.
8. Systems are not user-friendly.
9. Lack of standard IT policies, rules, and procedures.

Recommendations

1. The areas needing information systems improvements are the following, by order of priority:
    - Logistics
    - Employee Payrolls
    - Accounting and Financial
    - Commercialization
    - Manufacturing
    - Human Resources
    - Improve or replace basic systems using integrated systems including interconnected modules and applications for these areas, preferably with preprogrammed packages.
    - Client-server hardware architecture should be adopted by installing a local area network (LAN). Also, evaluate and follow up the use of AS/400 server capacity and standardize PCs.

- Organization-level recommendations:

  - Setting up an IT Steering Committee under the Management Committee to ensure basically that systems development would be aligned with business goals.
  - Enhance expertise in the IT division by hiring new personnel and training for present employees.
  - Change the IT division's organizational structure and create project- oriented teams. Also establish a systems career path.

ACKNOWLEDGMENT

The authors would like to express their gratefulness to Antonio Diaz-Andrade for his collaboration in this case and acknowledge the comments provided by the anonymous reviewers.

ENDNOTES

1. All individual names, company names, and brand names have been disguised.
2. Carlos Montero was away from *Alimentos Peru* from mid-1995 until the beginning of 1996.
3. After finishing the ERP system selection process and internal restructuring, the company's IT manager started reporting directly to the local general manager.

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Chapter XII: A Framework for the Selection of ERP Packages for Small to Medium and Large Organizations

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INTRODUCTION

An enterprise resource planning (ERP) system is a software infrastructure embedded with "best practices," respectively, best ways to do business based on common business practices or academic theory. The aim is to improve the cooperation and interaction between all the organizations' departments such as the products planning, manufacturing, purchasing, marketing and customer service department. ERP is a fine expression of the inseparability of IT and business. As an enabling technology as well as an effective managerial tool, ERP systems allow companies to integrate at all levels and utilize important ERP applications such as supply chain management (SCM), financials and accounting applications, human resource management (HRM) and customer relationship management (CRM). They represent large, complex, computerized and integrated systems, which can strongly influence long-term business success. ERP systems promise the development and sustainment of competitive advantage in the global marketplace through enhanced decision support; reduced asset bases and costs; more accurate and timely information; higher flexibility; or increased customer satisfaction (Davenport, 1998, 2000; Poston & Grabski, 2000; Rizzi & Zamboni, 1999). But the far-reaching structural changes following an ERP software implementation can also be disastrous as examples (Scott, 1999) show.

In this chapter we focus on the early stage of evaluating and selecting an ERP system prior to implementation. Only a part of decision making for ERP systems can be handled by a definite or accepted procedure such as standard investment calculations. There are many other intangible decision-making criteria needing to be judged and evaluated by the decision makers. There is no agreed-upon and formal procedure for this important task (Hecht 1997; Laudon & Laudon, 1998). Therefore it seems necessary to investigate decision-making practices to increase the understanding of this complex and important task. We also focus on the decision-making situation faced by small and medium-sized enterprises (SMEs). This is of particular importance because SMEs are more and more experiencing the need for integration, especially for interorganizational integration, and expecting ERP software to fulfill these needs. The availability of relatively inexpensive hardware is fostering this situation (Gable & Stewart, 1999). In general, decision making in SMEs features much greater constraints on the ability to gather information in order to reduce uncertainty about their investment (Cobham, 2000). Considering ERP software decisions with its complex and far-reaching implications, poor decision making by SMEs can result in disastrous situations.

On the other side, ERP vendors are in search for new challenges to generate higher revenues and have turned to the small and medium-sized market segment. In the last years ERP software packages sales flattened. A saturation of the market, as most large organizations have already implemented an ERP solution, decreased the annual ERP

market growth (Pierre Audoin Conseil, 1999). By 1998 approximately 40% of companies with annual revenues over US $1 billion had implemented ERP systems (Caldwell & Stein, 1998). The small and medium-sized market segment is far from being saturated (Pierre Audoin Conseil, 1999). The total European midsize market for IT products and services surpasses $50 billion per year (Everdingen, Hillegersberg, & Waarts, 2000).

The framework outlined in this chapter and the investigated research hypotheses represent a further step towards understanding the decision-making process for ERP investments and differences made by SMEs and large organizations. The groundwork of the proposed framework is supplied by a general process model for decision making derived from literature, which will be slightly adapted for the special needs of selecting an ERP system. For all relevant stages within this model, the findings contributing to the introduced research hypotheses will be analyzed.

RESEARCH HYPOTHESES

The research hypotheses presented below were derived from recent findings published in academic literature and suggestions from students, practitioners and researchers of our institute in the field of information system evaluation. The investigated hypotheses were closely related to practical problems, especially management pitfalls, often showing up when implementing and thereafter operating the chosen system, e.g., a low employee motivation.

Hypothesis 1: Most companies are choosing a participative evaluation strategy in the ERP system decision-making process.

An ERP implementation is much more than technology change; it also incorporates substantive changes to processes and the people involved. Change management effectively balances forces in favor of and against change (Kettinger & Grover, 1995; Stoddard & Jarvenpaa, 1995). The principles of change management especially apply to ERP system implementation. It is important that the employees relate to the new software environment. On that condition and with better change management practices, staff motivation will be higher. As has been argued (Appleton, 1997; Davenport, 1993; Hammer & Champy, 1993; Montazemi, Cameron, & Gupta, 1996; Willcocks & Sykes, 2000), the participation of the people affected by the system and knowing the business processes leads to better decisions and a higher rate of acceptance later on (Guha, Grover, Kettinger, & Teng, 1997). In Tayler (1998) possible benefits arising from a participative type of team structure include the motivational improvement of local participation and attention to individual quality of working life, as well as the necessary attention to strategic purpose and to reciprocal and coordinative social roles. On the other hand, it has to be noted that a participative form of decision making might lead to game-playing behavior if one or more parties try to influence the decision process to arrive at their preferred solution (O'Leary, 2000). Given this situation, we suggest that the majority of organizations implementing an ERP solution relied on a participative evaluation strategy.

Hypothesis 2: Organizations apply formal evaluation techniques other than conventional financial methods in the ERP system selection process.

The evaluation of information systems, especially ERP solutions, is one of the rather difficult problems to tackle in IT management. Nevertheless, at least one methodology from the vast set of evaluation techniques must be chosen in order to have a tool for an effective and transparent comparison of the different choices of action investigated.

Only conventional financial and economic evaluation techniques alone will not suffice. Research in IT has extended the range of tools to include productivity measures, return on management and information economics to name only a few and various taxonomies of methods have been put forward (Bannister & Remenyi, 1999; Jones & Hughes, 1999; Kontio, 1996; Lawlis, Mark, Thomas & Courtheyn, 2001; Remenyi, 1991; Sedigh-Ali, Ghafoor & Paul, 2001).

Decision makers tend to describe their decisions as being based to a greater or smaller extent on instinct or individual experiences. The more complex the decision, the more likely this seems to be. We suggest that a such defection from the solid ground of rational decision-making should be avoided. For every ERP software decision, formal evaluation methodologies should be applied. It has been confirmed that IT executives who systematically collected information and analyzed it made more effective decisions than those who did not (Ranganathan & Sethi, 2000).

Hypothesis 3: SMEs apply less formal and less complex evaluation techniques than large organizations in the ERP system selection process.

SMEs are usually much more informal and unstructured in their management style or definition of strategy. This allows them to compete in a very dynamic and competitive environment through high flexibility and responsiveness. This is a major premise for SMEs to be always close to their markets and customers. Regarding IT investments, many SMEs often seem to lack an explicit IT plan or strategy, or even a defined IT budget (Dans, 2001). Dans even states that decisions to adopt a particular technology are in many cases driven by personal attitudes or perceptions of the firm's owner, rather than by any formal cost-benefit or strategic analysis. Gable and Stewart (1999) proposed that a decisional specificity attributed to SMEs is less usage of formal models when evaluating SAP R/3 systems. Thus, we propose that SMEs apply less formal and less complex evaluation techniques than large organizations in the ERP system selection process.

Hypothesis 4: Higher flexibility is valued higher by smaller organizations.

As already noted, smaller organizations tend to be more flexible than larger ones. Their organizational structure is less rigid and can be changed more easily. The same applies to their business processes. Therefore, and also because they face greater environmental uncertainty due to lesser influence (Gable & Stewart, 1999), smaller organizations have the need and also the means to be more flexible. As the information systems in use have to be aligned with the business strategy and the current business processes, they also have to offer more flexibility to fulfill this requirement. The information systems in smaller organizations should therefore offer the possibilities to implement the current business processes, which might not necessarily follow the standards which are derived from larger organizations, and to be changed easily in order to accommodate changes to these processes. It can be assumed that this necessary requirement for increased flexibility will also affect the evaluation and selection of ERP packages.

Hypothesis 5: Smaller organizations spend less effort during all stages of the decision-making process.

Smaller organizations face more severe restrictions on their resources, including among others, financial and human resources. This "resource poverty" also constitutes part of the organizational specificity of smaller organizations (Gable & Stewart, 1999). Slack resources are often scarce or nil (Dans, 2001). It can therefore be assumed that this

factor plays a role in the context of ERP selection. This might include, for example, the ways in which information regarding alternatives and their respective quality is gathered and also the composition and size of the project team responsible for the decision making.

In the next section we will describe the applied methodology. This will be followed by the introduction of an ERP decision-making process model.

METHODOLOGY

This chapter draws on results from recent studies (Everdingen et al., 2000; Gable & Stewart 1999; Knolmayer, von Arb, & Zimmerli, 1997) and especially from results of an empirical investigation of ERP decision-making in Austrian organizations conducted by the Institute of Information Processing, Department of Information Business, Vienna University of Economics and Business Administration. Preliminary results concerning differences in the ERP selection process in SMEs and large organizations have already been published in Bernroider and Koch (2000).

For the empirical work, the design of a questionnaire was employed. On completion of the pilot testing, the mailing together with separate, prepaid envelopes followed. In all cases the senior management of the IT-department was contacted. (813)Eight hundred thirteen Austrian small/medium and large-size organizations were addressed and a return rate of 17% was achieved, which corresponds to 138 valid returns received between December 1998 and March 1999. The data was analyzed using a statistical package. Nonparametric statistics, such as chi-square, were calculated to test the independence of responses between small or medium-sized and large organizations. When analyzing the strength of a relationship between two variables the Spearman rank correlation coefficient has been used instead of the Pearson correlation coefficient because this analysis has been conducted only with ordinal scaled variables. For comparison of two independent samples that were not normal distributed (tested using Kolmogorov-Smirnov), a Mann-Whitney U-test was employed.

Of the 138 answers received, 22 (or 15.9%) belonged to small or medium-sized organizations. The remaining majority (116 questionnaires or 84.1%) was classified as large enterprises. Classification was performed using data on number of employees and turnover following the definition proposed by the Commission of the European Community (1996). A consequence arising from the different group sizes is that the precision of the estimates concerning the population characteristics of large organizations is likely to be more reliable compared to the case of smaller organizations, but the statistical tests employed account for the different sample sizes.

A DECISION-MAKING PROCESS MODEL

Making decisions is not a single activity that takes place all at once. The process consists of several different activities that take place at different times and that may be repeated. A general purpose stage model, which comprises all following activity types, based on Moorhead and Griffin (1998) and Griffin and Pustay (1996) can be seen in Figure 1. This model has been formalized by a process modeling technique used by some of the leading tools in the field of business process engineering such as SAP R/3 (SAP AG), ARIS (IDS Prof. Scheer GmbH), LiveModel/Analyst (Intellicorp Inc.) and Visio

(Visio Corp.). Process models made with this technique are called event- driven process chains (EPCs; Aalst, 1999; Scheer, 1998). This rational or normative model of decision making follows a systematic, step-by-step approach and suggests that managers apply logic and rationality in making the best decisions. Rationality implies that individual behavior has some purpose and that individual actions are systematic and logical in the pursuit of goals. Rationality has been a fundamental assumption in many disciplines like economics, organizational theory and corporate strategy (Ranganathan & Sethi, 2000). At the level of individual decisions, rationality implies gathering information pertinent to the decision, analyzing the information gathered, and generating and evaluating alternatives to make a final choice. Boynton and Zmud (1987) reported that many of the assumptions and premises that underlie the current planning literature reflect a rational model of organizational decision processes. Recent findings report positive impacts of rationality on decision effectiveness in IT decisions (Ranganathan & Sethi, 2000) and in the strategic management area (Dean & Sharfman, 1996; Priem, Rasheed, & Kotulic, 1995).

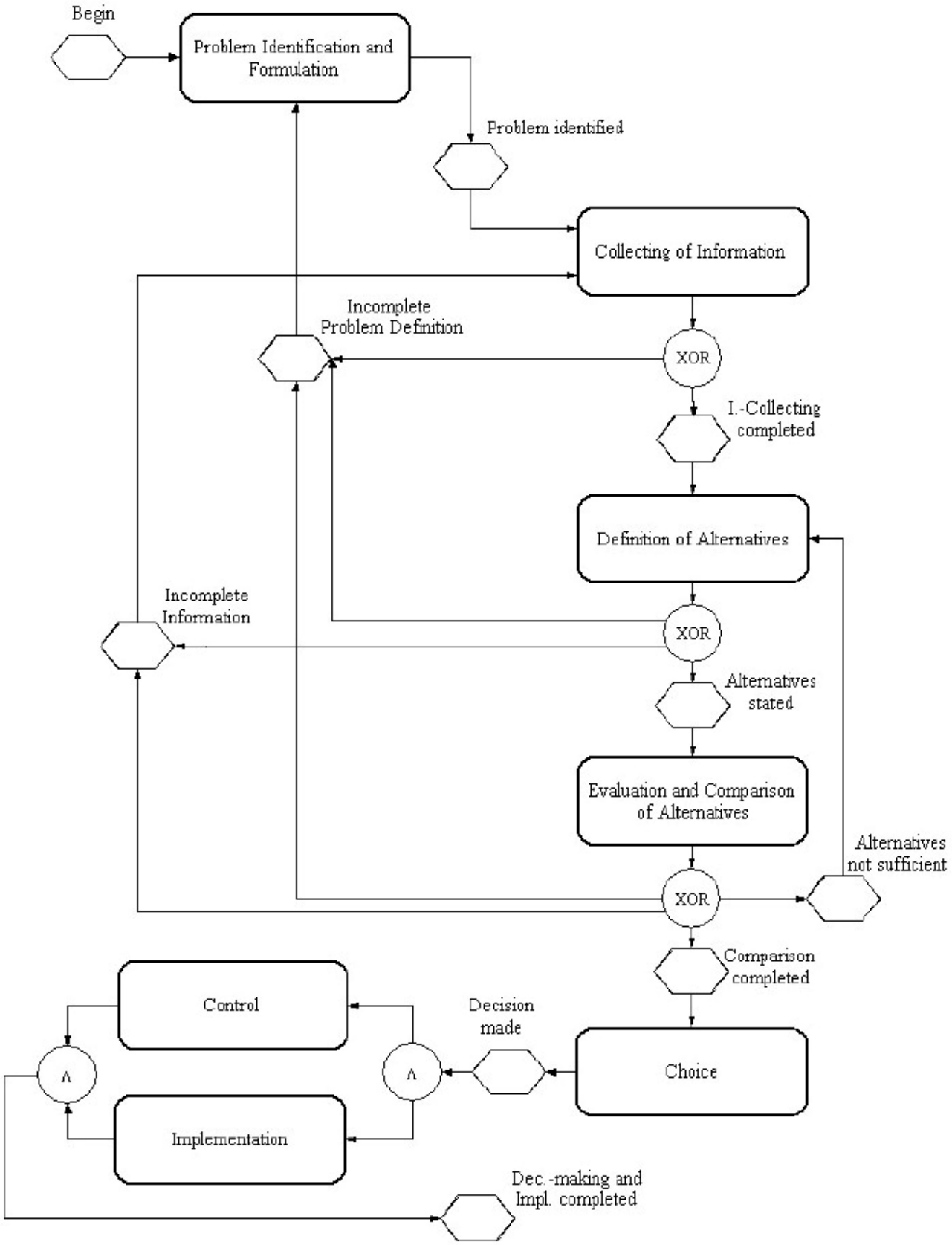
Begin
Problem Identification and Formulation
Problem identified
Collecting of Information
Incomplete Problem Definition
XOR
I.-Collecting completed
Definition of Alternatives
Incomplete Information
XOR
Alternatives stated
Evaluation and Comparison of Alternatives
Alternatives not sufficient
XOR
Comparison completed
Control
Decision made
Choice
Implementation
Dec.-making and Impl. completed

Figure 1: A general purpose decision model

The rational decision-making model proposed supplies a structural design, respectively, framework, which will be used to organize the ERP software decision-making-related information gathered.

Stages in Decision Making

1. 1) *Problem Identification and Formulation*: The rational decision-making process begins with the statement of problems and situational goals.
2. 2) *Collecting Information*: The second stage is where all information relevant for the problem identified is collected. It may be necessary to restate the problem formulation. For this case there is a feedback to Stage 1.
3. 3) *Definition of Alternatives*: In this stage all relevant alternative solutions to the identified problem are conceived using the collected information. It may not be possible to conceive all relevant alternative solutions with the information collected. Also, the problem formulation may be incomplete. For both cases a feedback link exists either to Stage 2 or Stage 3.
4. 4) *Evaluation and Comparison of Alternatives*: Every alternative solution needs to be analyzed in order to allow a comparison. During analyzing it might occur that the problem is not well-defined (back to Stage 1) or that information may be missing (back to Stage 2) or that other alternatives must be found (back to Stage 3).
5. 5) *Choice*: The selection is made within the various solution alternatives.
6. 6) *Implementation*: At this stage the decision is put into effect.
7. 7) *Control*: The progress of the solution needs to be controlled and verified with the identified problem formulation.

Simon's (1960) well-known decision model describes the following four different stages: intelligence, design, choice and implementation. The intelligence stage comprises Stages 1 and 2 of the above-presented model. Stages 3 and 4 belong to the design stage in Simon's model. Stage 5 corresponds to Simon's choice stage and Stage 6 corresponds to the implementation stage. Stage 7 (control) has not been included in Simon's model.

A MODIFICATION OF THE GENERAL DECISION-MAKING PROCESS MODEL

Aspects of ERP decision-making can be categorized in the following main areas:
Technical: This area comprises all hardware and software related resources needed to introduce the ERP system to the organization.
Organizational: The implementation of an ERP system induces organizational changes, which causes direct consequences on information flow, knowledge, culture, people, and tasks.

There is a mutual, bidirectional relationship between the technical and organizational aspects (Davenport, 1998).

An ERP decision produces not only large technical changes but also large organizational changes (managerial and institutional changes) that affect almost all employees in an organization. Many organizations have under- taken an ERP system decision and implementation (often together with major business process change initiatives) over the past 10 years. It has been indicated (Guha et al., 1997) that not only the technical aspects play a significant role in a successful decision and implementation process. Also the effective balancing of forces in favor of a change over forces of resistance is an important task. Organizations, groups, or individuals will resist changes that are perceived as a threat (Davenport, 1993; Guha et al.). All suggestions to overcome this problem in literature share the opinion that integrating agents from every business unit in the first stage of the decision process is a major supposition. To underline the importance of this matter, we therefore extend the general purpose model and define a new stage called composition of the project team, which is set between the former Stages 1 and 2 (see Figure 2).

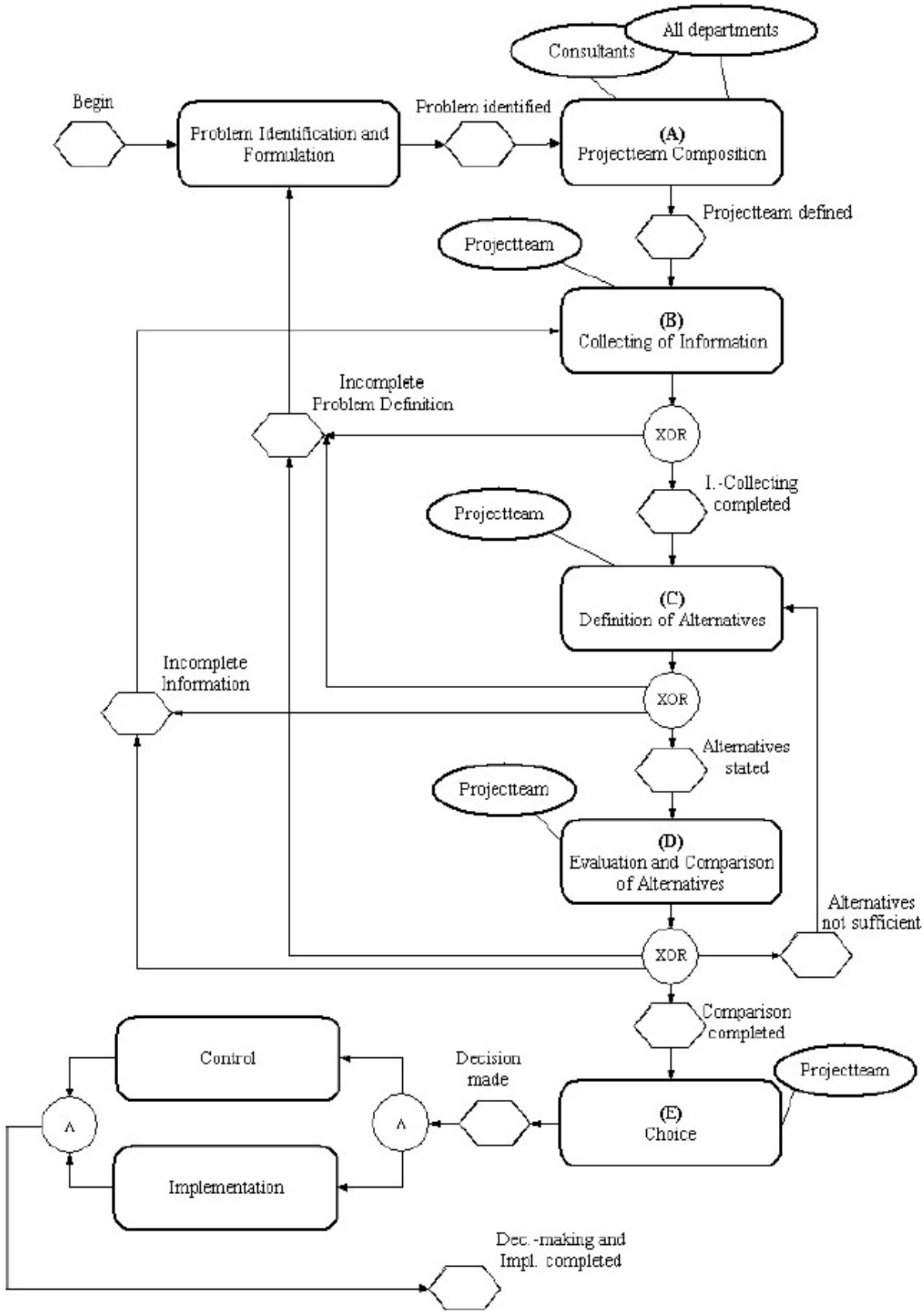
All departments
Consultants
Begin
Problem Identification and Formulation
Problem identified
(A) Projectteam Composition
Projectteam defined
Projectteam
(B) Collecting of Information
Incomplete Problem Definition
XOR
I.-Collecting completed
Projectteam
(C) Definition of Alternatives
Incomplete Information
XOR
Alternatives stated
Projectteam
(D) Evaluation and Comparison of Alternatives
Alternatives not sufficient
XOR
Comparison completed
Control
Decision made
Projectteam
(E) Choice
Implementation
Dec.-making and Impl. completed

Figure 2: An ERP decision-making process model

In the next section we will describe this newly introduced stage and four stages from the general model under the perspective of ERP decision differences between small to medium and large organizations. The activities further analyzed in this chapter are enumerated in Figure 2.

EMPIRICAL RESULTS

In this section and for every stage of the ERP decision-making process model, we will report findings contributing to the proposed research hypotheses.

Stage A–Project team Composition

As shown in (Bernroider & Koch, 2000), four different types for the structure of the selection group were identified from more specific data gathered:

1. Top-management decisions with the inclusion of external consultants (adopted by 17.6% of the organizations).
2. Centralized decision making characterized by a strong focus on the IT and organizational department with only small participation of other internal departments and no employment of consultants (10.9%).
3. Participative decision-making (35.3%).
4. Others, respectively diverse structures without a perceivable classification (36.1%).

Hypothesis 1 ("Most companies are choosing a participative evaluation strategy in the ERP system decision-making process") is strengthened by the fact that participative decision-making has been employed by the majority of the organizations. No differences were found indicating that SMEs utilize the participative form more or less extensively than large organizations.

Considering *Hypothesis 5* ("Smaller organizations spend less effort during all stages of the decision-making process"), the study has shown that smaller organizations use project teams for evaluation and decision making which are considerably smaller (Bernroider & Koch, 2000). In SMEs, the team size is in the mean 4.82 compared to 9.82 persons for larger organizations. As fewer persons mean less costs, this already contributes to the hypothesis in this early stage of the decision-making process. It can also be noted that SMEs tend to adopt a centralized decision within the IT and organizational department more often in relation to large organizations, maybe because of either a resulting reduction in costs or a lack of know-how in other departments.

Stage B–Collecting Information

The results of the empirical study strengthen *Hypothesis 5* ("Smaller organizations spend less effort during all stages of the decision-making process") in the context of information gathering. The data showed that smaller organizations employ less diverse approaches and also show a tendency for less expensive methods (Bernroider & Koch, 2000). For example, the analysis of a prototype or an evaluation by external consultants is used extensively by larger organizations only. Methods such as presentations by ERP system vendors and sending of a requirements catalogue are, in

contrast, used by nearly all organizations. In the mean, smaller organizations used 3.05 different approaches, larger ones 3.88 (out of 8 different possibilities provided).

Stage C–Definition of Alternatives

Considered alternatives in the decision-making process of Austrian enterprises were ERP solutions from SAP (87.5% of the organizations), Baan (44.5%), Oracle (32.5%), Navision (16.0%), J.D. Edwards (9.2%), Peoplesoft (5.0%) and other, smaller suppliers (47.1%; Bernroider & Koch, 2000). A similar situation was presented by the Department of Information Engineering at the Institute of Information Systems at the University of Bern (Knolmayer et al., 1997) for Swiss organizations. In both studies a strong presence of other, smaller suppliers was detected. This hints at a need for more specialized and less complex systems.

Stage D–Evaluation and Comparison of Alternatives

77.3% percent of the organizations used some sort of formal evaluation model in the ERP decision-making process. When excluding conventional financial methods, the rate drops to 30%, which contradicts *Hypothesis 2* ("Organizations apply formal evaluation techniques other than conventional financial methods in the ERP system selection process").

In order to investigate *hypothesis 3* ("SMEs apply less formal and less complex evaluation techniques than large organizations in the ERP system selection process"), the different types of formal evaluation approaches in SMEs and large organizations need to be analyzed. The data showed that smaller enterprises use for the most part only static investment methods, while large organizations also employ dynamic methods or other methods such as utilization ranking analysis or even real options (Taudes, 1998; Trigeorgis, 1996). The use of these methods correlates significantly with the size of the organization. *Hypotheses 3* is therefore strongly supported by the results of our study. It can be assumed that smaller organizations often rely on hermeneutic approaches (Bannister & Remenyi, 1999), defined as methods of interpretation of data which use nonstructured and nonformal approaches to decision making at the expense of the usage rate concerning more complex methods.

The last statement indirectly supports *Hypothesis 5* ("Smaller organizations spend less effort during all stages of the decision-making process"), as the application of more complex models would necessitate more effort.

Using the results of the study undertaken, differences in the weights attributed to selection criteria were observed (Bernroider & Koch, 2000). Contributing to *Hypothesis 4* ("Higher flexibility is valued higher by smaller organizations"), several aspects dealing with flexibility were rated differently. Goals to be achieved by the ERP implementation dealing with this point, e.g., increased organizational flexibility or improved innovation capabilities, were rated as less important by smaller organizations. While this might seem counterintuitive at first glance, it supports the notion that smaller organizations are more flexible from the start and therefore do not perceive an ERP package as a means to increasing their flexibility, in contrast to larger organizations. On the other hand, characteristics of the ERP systems concerned with the flexibility of the software itself, e.g., adaptability to business processes and flexibility to future changes, are rated higher. It can be seen that achieving a fit between the processes implemented by the ERP solution and the organization's idiosyncratic ways of working is more important for smaller organizations, which more often have some specific, not industry- standard

processes. These results are also in accordance with the findings of another survey on ERP adoption in European midsize companies (Everdingen et al., 2000). The authors also found that fit with current business processes and flexibility were the highest rated criteria for information system selection.

Stage E–Choice

The situation regarding the solutions chosen is similar with the solutions considered. SAP's dominance of the marketplace was clear (chosen by 69.8% of the organizations). Again, smaller companies have captured quite a large market share (23.3%) with Oracle (13.8%) and Baan (11.2%) being the only other contenders of larger size (Bernroider & Koch, 2000). Both the leading position of SAP and the relatively large market share for smaller suppliers are in accordance with the findings of a comparable European survey of midsize companies (Everdingen et al., 2000).

Pertaining to *Hypothesis 4* ("Higher flexibility is valued higher by smaller organizations") and in accordance with the results detailed for Stage D (evaluation and comparison of alternatives), the higher rating of SMEs for flexibility-related criteria concerning ERP system alternatives also affects smaller organizations' selection of vendors. For example, the software supplied by Baan, which is believed to be more flexible than the rival SAP product (Markus & Corenelis, 2000), is chosen more often. SAP R/3 on the other hand is selected more often by large organizations.

Hypothesis 5 ("Smaller organizations spend less effort during all stages of the decision-making process") concerning Austrian companies is proved when investigating overall duration and costs for decision making including all phases, which are significantly lower for SMEs. The mean duration is 17.57 weeks compared to 30.04 weeks; the costs are about 30.000 Euro compared to 77.000 Euro for larger organizations. While also the results given for several phases above have hinted at the correctness of this hypothesis, these findings prove the difference between organizations of different sizes.

CONCLUSION

In this chapter the decision-making process for the evaluation and selection of ERP packages has been explored. Given the importance of ERP system implementation for business success in most organizations, this area seems of high importance but has not yet received particular interest from the IS research community.

Therefore, we have presented a framework for the selection process based on academic literature and the results of an empirical study. Special consideration was given to the differences between small/medium and large organizations. It was assumed that these differ in several phases of the decision-making process. As most ERP system suppliers are today striving to penetrate the market segment of small to medium enterprises, with the market for large organizations mostly saturated, this point also warrants particular interest.

We have formulated 5 hypotheses closely related to practical problems, which were derived from a review of recent academic literature and suggestions from students, practitioners and researchers. Using a framework supplied by a decision-making process model and results of empirical studies, the hypotheses relevant for each stage were investigated. Most of the differences uncovered were caused by the specificities of

smaller organizations, for example, their lack in resources of both financial and human nature.

For example, it has been found that while a high percentage of organizations adopts some sort of participative form of decision making, as is also proposed by many researchers and practitioners, smaller organizations show a higher tendency to a centralized form centered in the IT department and also use teams of much smaller size in the whole process. In addition, the decision in this group of smaller organizations is based on less complex, formal and expensive methods of information gathering. The criteria for the selection of a particular ERP system were also different, as smaller organizations, which mostly are more flexible today and have a pressing need to conserve this, do not see an ERP package as offering them a chance to become more flexible but demand a high flexibility from the software itself, so as to be able to adapt it to their current, not necessarily industry-standard business processes and to be able to quickly adapt to new process changes the environment might make necessary. The decision-making process overall can be shown to take both less time and cost for smaller organizations.

Further research would be needed to deal with the differences between small/medium and large organizations in later phases of the ERP system life cycle. Especially implementation and usage of the chosen package might also differ between these types of organizations. The findings should then be condensed into one coherent framework for the whole ERP life cycle in organizations.

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Chapter XIII: A Study of the ERP Selection Process in New Zealand

OVERVIEW

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This study provides an exploratory investigation of the enterprise resource planning (ERP) software selection process in New Zealand. A brief background together with the main features of ERP is provided. It is conferred in this study that the selection and implementation of ERP deserves equal importance. Findings of exploratory case studies on the ERP selection process in New Zealand (NZ) suggest that the selection of ERP guides the implementation process. It is also evident from the study findings that most New Zealand organizations select their consultants and let them guide the ERP selection, implementation, as well as post-implementation process.

INTRODUCTION AND BACKGROUND

The focus of this study is to develop an understanding of the selection process of ERP systems for SMEs in New Zealand. A case study approach is used here to collect data in relation to the involvement of different interest groups in the selection process of ERP systems. New Zealand companies have realized the true benefits of the use of ERP for managing their business operations. The current rate of ERP implementation in New Zealand suggests that about 75% of large companies have implemented and some have planned for ERP implementation. A recent ERP survey in New Zealand suggests that the top three reasons for implementing includes improving customer service or streamlining operations, reducing operational expenses or an increase in efficiency, and gaining competitive advantage (Mills, 1999; Wells, 1999).

A review of the industry literature suggests that the high-end market for ERP in New Zealand is saturated. For this reason, ERP vendors are planning for compact packages, pay-as-you-use pricing, and outsourcing strategies to penetrate the low-end market. This provides an early indication of the selection and implementation of ERP for the low-end market of SMEs. Table 1 provides a summary of survey results of top 100 companies in New Zealand and their interest in implementing ERP.

Table 1: Summary of survey results of top 100 companies in New Zealand and their interest in ERP implementations (Mills, 1999; Wells, 1999)

Percentage of companies	Plans regarding ERP implementations (15% response rate)
25	no plans for implementing ERP (most of these companies have between 50 to 99 employees with an annual revenue of less than $10 million)

Table 1: Summary of survey results of top 100 companies in New Zealand and their interest in ERP implementations (Mills, 1999; Wells, 1999)

Percentage of companies	Plans regarding ERP implementations (15% response rate)
25	have already implemented ERP
25	are in the process of implementing ERP
25	have plans to implement ERP within the next 12-24 months

It is important to note that the ERP market for New Zealand is different from other larger markets like Europe and North America. The present ERP implementation in New Zealand reveals that unlike the US market, only the basic solutions of ERP are available in New Zealand. It is also evident that the New Zealand clients for ERP can afford to pay less than the US counterpart. Therefore, ERP vendors have to adjust their prices to compete and develop other alternative measures to support the growth of ERP implementation in the lower-end market for the SMEs.

Table 2 provides a longitudinal view of the ERP industry in a New Zealand context. The process for developing this table included searching two New Zealand electronic databases, "Newzindex" and "Newztext Newspapers," for a combination of two key words, "ERP" and "selection." Each article in the search results list was read to confirm its topic relevance. Several articles were excluded because they were irrelevant to the topic of investigation. Each article in the validated list was analyzed to identify themes. A theme table was then produced where major themes formed the rows of the table and publication years formed the columns. No formal method was used to develop the theme list. It was more a creative process than one that followed rules.

[1] The search was carried out on the 16th of June 1999 and covered publications dated 1997 till the end of May 1999. Search results for the "Newzindex" database resulted in 43 matching of 5,288,162 documents. Most of the matching titles were articles in *Computerworld New Zealand*. Search results for the "Newztext Newspapers" database resulted in 75 matching of 482,554 documents. Most of the matching titles were articles in *NZ Infotech Weekly*.

Table 2: A review of ERP industry in New Zealand context

Trends in the ERP implementation industry literature	1997	1998	1999
Portfolio Approach	No	No	Yes
Small and Medium Enterprises (SMEs)	No	Yes	Yes
Research and Surveys	No	Yes	Yes
Fixed Price ERP	No	No	Yes
CRM	No	No	Yes
Outsourcing ERP	No	Yes	Yes

Table 2: A review of ERP industry in New Zealand context

Trends in the ERP implementation industry literature	1997	1998	1999
Partnerships	No	Yes	Yes
Compact Packages	No	No	Yes
OO Programming Paradigm	No	Yes	Yes
Supply Chain Management (SCM)	No	Yes	Yes
Management Framework	Yes	Yes	Yes
ERP Consultants	No	No	Yes
Application Integration	No	Yes	Yes

It can be seen from the ERP trends in New Zealand that most of the organizations have had only management framework in place in 1997. During 1998 and 1999, most of the SMEs have taken a step towards ERP implementation. It is also evident from the table that New Zealand invested in ERP research and surveys at that time. Other issues such as CRM, outsourcing, formation of partnerships, OO programming, SCM and application integration became important during 1998 and 1999. In 1999, New Zealand introduced three new approaches–portfolio, compact packages and the use of ERP consultants for the selection and implementation of ERP. At this stage, it is also important to have an understanding of ERP implementation practices from a global perspective. Therefore, a background to ERP implementation and its context from a global perspective is presented below.

ERP IMPLEMENTATION AND ITS CONTEXT

ERPs are prepackaged software applications that integrate information across the entire organization (Davenport, 1998). This integration removes inconsistencies and assists the organization in attaining their consolidated reports. ERP systems are available from vendors such as SAP, Oracle, PeopleSoft, J.D. Edwards and Baan, which represent the five top-tier ERP vendors. The major features of ERP systems are as follows (Davenport, 1998; Markus & Tanis, 2000; Ross & Vitale, 2000):

1. ERP systems are considered to be standards of business best practice;
2. An ERP system includes a set of two or more standard integrated modules, each modelling a certain business process or function;
3. Organizations can choose a minimum set of modules to implement and add other modules as necessary;
4. 226
5. The integration of ERP systems is built within the system, removing any inconsistencies of information across an organization; and,
6. The selection and implementation of an ERP system takes at least 6 to 24 months and involves the resources and commitments of different stakeholders from inside as well as outside the organization.

The origins of ERPs are the MRP systems (Chung & Snyder, 1999; Davenport, 2000; Deloitte Consulting, 1999; Kumar & Hillegersberg, 2000; Palaniswamy & Frank, 2000). The MRP families like MRP (materials requirement planning) and MRP-II (materials resource planning) were focused mainly on manufacturing and logistics operations while ERP systems support the integration of other functions like accounting, finance, sales, marketing, human resources and others (Davenport, 1998). Each function is supported by one or more modules, which are designed to integrate into other modules; however, configuration and customization is needed during implementation.

ERP systems have recently evolved to support other functionalities that, until recently, were offered separately, such as supply chain management (SCM), customer relationship management (CRM), professional service automation (PSA), data warehousing (DW) and artificial intelligence (AI). Table 3 presents a historical outline of the evolution of ERP systems and traces their origins from the 1960s to the 21st century. The table outlines the focus of the application, the supported IT architecture, application users and the level of integration provided. It is observed from the table that ERP systems have evolved to include more modules, wider business focus and more users from inside as well as outside the organization. While architecture supporting ERP was mainly centralized in the early stages of ERP evolution, it is now a mix of centralized and distributed solutions, which became available and feasible during the 1990s.

During the late 1990s, the high end of the ERP market became saturated because most large organizations have already implemented an ERP system. In a response to competition in the industry then, ERP application vendors started including other applications as part of their ERP offerings. ERP systems evolved to become "interorganizational" and "Internet enabled." New modules that were added to the product portfolio included CRM, DW and AI. In order to achieve that, ERP vendors built the new functionalities in- house and acquired or made partnerships with specialized enterprise application vendors. Future ERP applications are predicted to have less focus on transaction processing, to include managerial support systems as standards of its offerings, and to support various documents types, such as multimedia and CAD (Kumar & Hillegersberg, 2000).

Table 3: The evolution of ERP systems

Systems	Year	Focus	Architecture (Technology)	Users	Level of integration
IC (customized inventory control software packages)	1960s	Inventory control based on traditional inventory concepts.	2-tier architecture (mainframe)	Plant managers and supervisory staff	No integration
MRP (materials requirement planning)	1970s	A high-level scheduling, priority and capacity management system, which is built around a bill-of-material process in a manufacturing environment.	2-tier architecture (mainframe)	Plant managers and supervisory staff	Minor integration
MRP-II (manufacturing resources planning)	1980s	An extension of MRP to shop floor and distribution management activities.	2-tier architecture (mainframe)	Plant managers and supervisory staff	Integrated within the manufacturing environment but not to other functions of the organization
ERP (enterprise resource planning)	1990s	MRP-II was further extended to cover areas like engineering, finance, human resources, projects management, etc. (i.e., the complete set of activities within a business enterprise).	3-tier architecture (client-server) RDBMS object-oriented programming	Managers , supervisory staff and end users	Integration between the functions of the organization including multisite integration
ES, ERP II or ERP of the future (enterprise systems)	2000s	Most ERP systems are enhancing their products to become "inter-organizational" and "Internet Enabled." New modules are added to the product portfolio, i.e., CRM, SCM, data warehousing and AI.	A mix of centralized and distributed architecture (client-server and Internet networking)	Intra- as well as extra-organizational stakeholders (suppliers, customers, partners)	Integration inside as well as outside the organization

Organizations had different drivers for implementing their ERP systems (Ross, 1999, pp. 65). There are two main categories to the classification of these drivers. The first is concerned with solving existing business problems, which included the Y2K problem, inadequate IT infrastructure, and disparate information systems, particularly in the case of mergers and acquisitions. The second was related to improving future business operations, which addressed supporting future business flexibility and growth, reducing operational costs, supporting customer responsiveness, improving data visibility, and making better business decisions.

The primary benefits of implementing an ERP system are operational efficiency and strategic effectiveness. Organizations in implementing an ERP system aim to achieve consistent information systems that are up-to- date. Organizational efficiency is achieved by linking organizational business processes into one system that enables companies to minimize resources required to complete their business processes. Furthermore, organizational effectiveness is realized by enabling better decision making through the use of up-to-date reports that become available across the business in different directions.

The adoption of ERP systems until the late 1990s was by large organizations that could afford the high cost of the system implementation. Most of these organizations were implementing ERP systems to replace their old legacy systems. Furthermore and since most of the ERP systems were Y2K compliant, organizations implemented ERP to deal with the Y2K issue as well. When the market for ERP in large organizations became

saturated by the year 2000, small-to-medium enterprises (SME) were perceived to be the future area of growth in the ERP market. In responding to this saturation of ERP markets, ERP vendors as well as other enterprise applications vendors started developing new and different strategies that would appeal to the two main market segments of SME and large organizations. Each of these strategies is briefly discussed.

The first is the *ERP compact package*. Compact packages are on-the- shelf packages that are low in price when compared to the standard ERP package but can be implemented in less time. These compact packages include the basic functionalities of the software but less options for customization. They are designed to cater to SMEs by offering them the advantages of a standard product that includes best practice, however it is less expensive and can be implemented quicker. The second strategy is the *ERP outsourcing* or the *application service provision (ASP)*. In offering this, the vendor finds a computer services partner to mount the ERP systems on its own machines and offers online services to customers. Customers are required to pay either by transaction or by seat per month. Customers benefit by avoiding the high cost of software purchase as well as the huge capital investment of in-house hardware, however they are still required to pay the cost of setting out the system. This strategy can be equally appealing to SMEs and large organization where the choice will probably be determined in a trade-off between more efficiency but less independence to the organization implementing the outsourced ERP system. In 1999, SAP partnered with EDS in North America to outsource its R/3 product. SAP also started the partnership negotiation process with both EDS and Datacom in New Zealand (Bell, 1999). The *best-of-breed* or portfolio approach is considered the third strategy. Buying an ERP package is regarded as an alternative to integrating a number of best-of-breed applications (Davenport, 2000; Pullar-Strecker, 1999). While ERP vendors started making their products more standardized to facilitate integration to other products, it is the specialized consultants that commonly offered process integration, where financial applications of one vendor, for example, were integrated to other vendors' applications for the same client organization. Because of the complexity and expensive implementation of best-of-breed applications, they are likely to appeal to large organizations that can afford the high cost of extra functionality. Fourth, the *new implementation methodologies and pricing policies* are similar to what compact packages offer but include the use of the basic ERP solution. The main aim of this strategy is to make ERP more affordable in price plus decreasing the length of time the systems needs to be implemented. While the strategy may have targeted organizations of an SME size, it is considered a valid alternative to large organizations that need to be convinced of the viability of these ERP systems through the promise of quick results and minimum risks. Fifth, promoting the *Internet B2B e-commerce* capabilities of ERP systems is a strategy that attracts large organizations, however it can also be equally appealing for SMEs. Finally, including other *specialized applications* such as AI and DW as part of the ERP product is a strategy some of the first-tier ERP vendors utilized mainly to target large organizations. Figure 1 represents these ERP strategic offerings across a market spectrum for SME and large organizations.

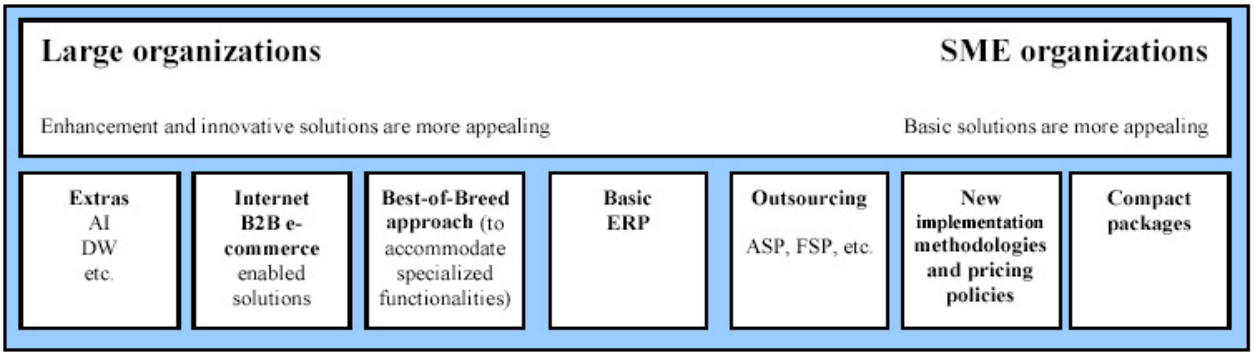

Figure 1: Different ERP strategies for SME and large organizations

ERP systems are offered by five major vendors–SAP, Oracle, PeopleSoft, Baan and J.D. Edwards. However, there are strengths-weaknesses-opportunities-threats (SWOT) of the ERP systems offered by the aforementioned vendors. Table 4 provides a snapshot SWOT analysis of the five leading vendors' ERP offerings during the period from mid-1999 until mid-2000. This table was developed using secondary data collected from vendors' Web pages, their promotional marketing products and the ERP practice literature. Data was structured into a 6-column matrix where the 5 right columns include vendors' data while the 6th column to the left includes the categories across which these five vendors are compared. Table 4 is divided into two sections. The first section includes a collection of information about each of the top vendors across four dimensions, which are the vendors' organization, the ERP product, new ERP product offerings, and services, partnerships and community involvement. These four dimension are illustrated in Tables 4-a, 4-b, 4-c, and 4-d, respectively. The second section of Table 4 (which is labelled as Table 4-e) includes the SWOT analysis of the five vendors. Analysis was aided by the structured data in section one of Table 4 plus the review of practice literature; consultants' Web sites and marketing material; ERP electronic newsletters; and discussion groups during the period 1999-2000. It is acknowledged that there have been many changes in the ERP industry since then. However, it is believed that the period of investigation was a turning point in the evolution of ERP systems, as reflected earlier in Table 3 thus it is worth documenting. Furthermore, the IT industry and ERP systems included, are in a continuous mode of change, making it impossible to produce current status summaries because they tend to become obsolete very quickly.

Table 4-a provides the vendor profile and revenue of the ERP systems for each of the five leading vendors. It can be seen from this table that SAP had achieved the highest revenue among the other four ERP vendors. SAP is considered the largest ERP vendor and market leader in the sale of complex back-end ERP software. It is also important to note that among the five ERP vendors, SAP has the highest expenditure in research and development of new and innovative products. SAP has installed its software in about 12,000 companies resulting in more than 25,000 business installations and more than 10 million licensed users worldwide. SAP entered the New Zealand market in 1995. During 1995 to 1998, SAP has introduced their R/3 system to 60 New Zealand customers with a turnover of $50 million in 1998 (Perry, 1999).

Table 4-b compares the different ERP products across the five vendors. It is observed in this table that ERP vendors started branding their ERP products as Internet-enabled or the "e-enterprise product." Internet e-commerce was and still is perceived as a major

driver to the growth of ERP markets. Furthermore, Internet B2B e-commerce is projected to grow to $1.5 trillion by 2004 (Janzen, 1999). This e-commerce market is enabled through the integration of Web-enabled front-end applications to a back-end ERP system. It is proposed that only in achieving both external and internal integration of organizational information systems that organizations become in a better position to get the benefits throughout their supply and value chains (Hammer, 2001). Another report by International Data Corporation (IDC) shows that 58% of companies surveyed about IT spending for the year 2000 were putting money back into mission-critical applications that included ERP and CRM systems (Scannell, Nelson, & Briody, 1999). The next application category in the IDC report is Web-enabled and e-commerce applications, which 23% of the companies surveyed planned to dedicate funding to. Table 4-c illustrates the new ERP product offerings presented earlier in Figure 1, while Table 4-d provides background information on services, partnerships and community involvement of the five vendors.

Table 4-a: A SWOT analysis of the different ERP systems offered by the top 5 vendors: The vendor's organization

	Baan	J.D. Edwards	Oracle	PeopleSoft	SAP
Section one: Information summaries of the top five ERP vendors					
Main source of information (Web page last accessed: May 2000)	http://www.baan.com/	http://www.jdedwards.com	http://www.oracle.com/	http://www.peoplesoft.com/	http://www.sap.com/
Information about the vendor's organization					
Founded	1978	1977	1977	1987	1972
Headquarters	Barneveld, The Netherlands, and Herndon, Virginia, U.S.A.	Denver, Colorado, U.S.A.	Redwood Shores, California, U.S.A.	Pleasanton, California, U.S.A.	Walldorf, Germany
Revenue in 1999 (in million of $)	$634.8	$944	$2,168[2]	$1,400	$5,145
Employees worldwide	4,700	5,400	43,000	more than 7,000	over 21,700 people in more than 50 countries
Customers	13,000 customer sites	6,000	more than 7,000 (includes supporting other Oracle products)	4,000	12,000 companies (more than 25,000 business installations and more than 10 million licensed users worldwide
Countries	Not available	100 countries (48 offices)	76	Not available	more than 110 countries
Languages	Not available	21	29	Not available	28
Currencies	Not available	Not available	Multiple	Not available	46 country-specific versions
Corporate philosophy	Baan embraces a corporate philosophy that is characterized by "the three A's," which represent Ability, agility and accountability; and "the three Is," which represent innovation, integrity and initiative.	The company attributes much of its success to a corporate culture that emphasises solutions, relationships, and value. The company is committed to technical quality in the forms of ISO 9000 certification and support for the Malcolm Baldridge principles. J.D. Edwards' commitment to product quality, its corporate culture and a customer-centric, value-based approach enable the company to deliver and support leading enterprise software solutions that solve business problems now and in the future.	Oracle's commitment to excellence and quality goes beyond our immediate business concerns. At Oracle, we are strongly aware of our ability and our responsibility to make a difference in the global community.	Core values are people, customers, integrity, quality, innovation and fun.	Permanent innovation gives SAP the leading position in the worldwide market. The driving force behind that are the 5,400 research and development employees worldwide. One in four of SAP's employees are working on developing new solutions or improving existing ones. SAP solutions give customers the strategic infrastructure that they want to grow the productivity and job satisfaction of their employees and to exploit new openings for business.

Table 4-a: Table 4-b: A SWOT analysis of the different ERP systems offered by the top five vendors: The ERP product

	Baan	J.D. Edwards	Oracle	PeopleSoft	SAP
Section one (continued):					
Section one: Information summaries of the top five ERP vendors					
ERP product	BaanERP	Active Enterprise, powered by OneWorld	Oracle Applications	PeopleSoft	SAP
ERP product Release	BaanERP is the successor to Baan IV	ActivEra™ Solutions	Oracle Applications Release 11i	PeopleSoft 8	SAP System R/3, 1992
ERP product vision	Baan enterprise solutions enable companies to reduce software complexity and cost, enhance ease of use, and bring value to a company's own customers (mid-market and large-scale multinational companies) and partners.	What most distinguishes J.D. Edwards is its customer-centric Idea to Action™ value proposition. J.D. Edwards' Idea to Action™ ensures customers get solutions their organization needs through the use of information technology efficiently throughout the virtual enterprise and in tailoring applications to meet changing business.	Oracle Applications are architected to take advantage of the Internet and shift the complexity of applications from users' desktops onto centralized servers, thereby reducing the cost of deploying and administering software. This approach also makes it economical to deploy the applications over wide area networks (WANs) to hundreds or thousands of users, which is more feasible than the client/server model.	PeopleSoft applications offer greater flexibility, rapid implementation, scalability across multiple databases and operating systems, and lower cost of ownership. Customers include some of the largest multinational organizations in the world, as well as small and medium-size businesses. All PeopleSoft products are backed by Advantage Customer Service, a comprehensive consulting, education, and technical support program.	The ability of SAP to deliver customer-centric, open, personalized and collaborative inter-enterprise solutions on demand is the foundation of mySAP.com™.
E-Enterprise product	Baan E-Enterprise	ActivEra™ Solutions	E-Business Suite Release 11i	PeopleSoft 8	mySAP.com
E-Enterprise product released	1999	1999	2000	2000	September 1999

Table 4-a: Table 4-c: A SWOT analysis of the different ERP systems offered by the top five vendors: New ERP product offerings

	Baan	J.D. Edwards	Oracle	PeopleSoft	SAP
Section one (continued):					
Business-to-business (B2B) marketplace	Not available	J.D. Edwards entered into in a strategic alliance with **Ariba** to integrate Ariba® B2B e-commerce solutions with OneWorld™ (April 1999).	**OracleExchange.com** is an online open B2B marketplace, while **GlobalNetXchange** and **RetailersMarketXchange** provide a central meeting place for companies from the same industry.	PeopleSoft established partnership with Commerce One (an industry-leading MarketSite portal solution) to deliver B2B eTrading exchanges (April 2000).	**mySAP.com Marketplaces** are open Internet business hubs that encompass content, community, collaboration, and commerce.
Outsourcing or the ASP offering (launched in)	Not available	JDE.sourcing, 1998	Oracle Business OnLine, 1998	PeopleSoft eCenter, 2000	**mySAP.com Application Hosting,** 1999
ASP definition	Not available	Deliver hosted software solutions to customers of all sizes in a wide array of vertical industries.	Oracle runs applications software as a service for other businesses, rather than having those businesses run the software themselves.	Combines tightly integrated, award-winning applications with standard-setting data centre services and industry-leading customer service.	Allows for just a few applications hosted or to have your entire online business community hosted (nearly 10,000 users by May 2000).
Compact package	Baan-on-Board	Not available	Oracle's FastForward	PeopleSoft Select for SMEs	AcceleratedSAP™ (1992)
Compact package definition	Baan-on-Board bundles hardware, software, database support training materials and implementation tools. Being an all-in-one package, Baan-on-Board comes pre-loaded, pretested as an industry-specific solution.	Not available	A family of solutions specifically designed for mid-sized companies to offer accelerated implementations of Oracle applications and platform technologies. Solutions are also available on a hosted basis.	**PeopleSoft Select** is a complete hardware and software solution for companies with revenues up to $250 million. It includes all services needed to get the system up and running–at an affordable price.	ASAP is SAP's rapid implementation solution specifically designed to streamline and standardize the implementation process to achieve mission-critical business functionality as soon as possible (ASAP).
CRM	BaanFrontOffice	J.D. Edwards Active Customer Relationship Management (CRM) is a result of a joint venture between J.D. Edwards and Siebel Systems.	Oracle CRM 3i	PeopleSoft acquired Vantive, a leader in CRM products in late 1999 and is integrating Vantive's CRM offerings to PeopleSoft.	SAP, entering into a strategic alliance with Nortel Networks, decided to abandon its own CRM to replace it with Clarify, Nortel's CRM eBusiness software (Konicki, 2000).
Data warehousing	Not available	J.D. Edwards has the tools but no details are provided.	Oracle's **Warehouse Technology Initiative**	Not available	SAP **Business Information Warehouse™**
Business intelligence	Not available	**J.D. Edwards Business Intelligence** includes: balanced scorecard, analytical applications, data mining applications and OLAP	**Oracle's Business Intelligence**	**PeopleSoft Enterprise Performance Management** includes: balanced scorecard and workforce analytics, enterprise warehouse and activity-based management	Business intelligence applications include: **SAP Business Information Warehouse™** and **SAP Strategic Enterprise Management™**

Table 4-a: Table 4-d: A SWOT analysis of the different ERP systems: Services, partnerships and community involvement

	Baan	J.D. Edwards	Oracle	PeopleSoft	SAP
Section one (continued):					
Partnerships	11 application service provider partnerships and more than 200 reseller relationships; also, software alliance, Baan consulting alliance and technology alliance	300 partners ranging from consulting firms to small organizations, providing service to customers in remote locations	Oracle Partners Program (OPP), which has more than 18,500 members	PeopleSoft works with more than 250 technology, software, and service partners–including leading eBusiness and Internet computing companies.	more than 900 partners and 10 million professionals
Consulting	14,000 trained consultants	J.D. Edwards Select consulting Partners	more than 15,000 consultants in over 90 countries	PeopleSoft offers a wide range of consulting services through a team of 2,000 PeopleSoft professional services and implementation partners.	45,000 consultants around the world trained in SAP software
Education and training	Baan Education believes in a hybrid approach to effective learning. They offer three primary learning platforms to suit key users, technical users, and end users of BaanSeries. The platforms are Instructor-Led Classroom Training, the Baan Virtual Campus, and Baan LIVE!.	J.D. Edwards features seven state-of-the-art Training Centres in North America and over 20 locations worldwide.	170 instructor-led courses offered in 300 education centres located in 70 countries	PeopleSoft Education products and services include: products, end-user training kit, PeopleSoft knowledge centre, CD-ROMs and CBTs services, implementation team training, course customization and new course development, PeopleSoft end user training , kit implementation services workforce performance, solutions, customer site training services.	SAP has one of the largest information technology training companies in the world, offering standard classroom training with more than 150 instructors teaching more than 200 courses at 85 training centers worldwide. SAP also offers remote training and the SAP University Alliance Program.
Community involvement	Not available	Not available	**Oracle Volunteers, Oracle Corporate Giving** (Giving funds and building partnerships with nonprofit agencies and schools), **Oracle's Promise** (providing computers to public schools in low-income neighborhoods) and **Sponsoring the Special Olympics**	PeopleSoft takes great pride in serving communities where employees work and live. Community services include: charitable contributions, volunteering, giving guidelines, proposal process and computer/product donations	Not available

Table 4-a: Table 4-e: A SWOT analysis of the different ERP systems offered by the top five vendors

SWOT	Baan	J.D. Edwards	Oracle	PeopleSoft	SAP
Strengths	Expertise: Manufacturing knowledge. Market share: Target market. Favors SME, which is expected to be the future area of growth for ERP.	Expertise: Specialized offering such as construction, engineering, etc.	CRM: 1st to include CRM as part of the ERP product. Databases (DB): World leader in DB sales. E-Commerce: 1st to offer Internet capability to the ERP product. Expertise: Financial applications. Financial results: The best of the top 5 vendors. Implementations: Managed by the vendor.	Expertise: Human resources.	Customers: Largest customer base. Customization: More options. Expertise: Manufacturing knowledge. Market share: Market leader. Partnerships: Partnerships with all the big five consulting firms, hardware vendors, ASPs, AIs and universities. Research and development: Highest research and development expenditure plus the university alliance program.
Weaknesses	Financial results: The worst of the top 5 vendors.	CRM: No CRM product developed internally.		CRM: No CRM product developed internally but recently acquired a CRM vendor.	Clients' satisfaction: Disgruntled clients as "up to 30% of all SAP implementations fail to meet the buyer's expectations" (Girard & Farmer, 1999). Complexity: Is high. Need more time and resources to configure. Price: Expensive. Resources required to implement: Time- and resource-consuming. Specialization: Focus is on the core ERP modules.
Opportunities	E-commerce Implementation methodology Outsourcing	E-commerce Implementation methodology	Compact packages E-commerce Implementation methodology Outsourcing	E-commerce Implementation methodology	E-commerce Implementation methodology Outsourcing
Threats	Competition: From large as well as small vendors.	Best-of-breed offerings Specialized solution	Best-of-breed offerings Specialized solution	Law suits Best-of-breed offerings Specialized solution	Law suits: For failed implementations. Best-of-breed offerings: Picking the best and integrating. Specialized solution: Especially by small and start-up competitors.

[2] Oracle revenue calculated to a similar percentage of its 1998 revenue using the figures published by Enzweiler Group (1999). Oracle's revenue published on its Web site is $8,800 million and includes database sales as well as Oracle applications.

The SWOT analysis of the top five ERP vendors in Table 4-e shows that the five vendors share similar opportunities and threats for the future. Opportunities include offerings that attract SMEs, which are the compact packages, fast-track implementation methodologies, new pricing policies and outsourcing options. The table also predicted that the market for B2B e-commerce would experience a huge explosion in the future, where all the five vendors are perceived competing to get their presence. Threats include lawsuits as a result of failed implementations and disgruntled clients. Small competitors, specialized solution providers and best-of- breed offerings also pose a threat to the traditional ERP vendor.

SAP and Oracle strengths are noticeable. SAP's strengths are a result of it leading in the number of customers, market share, research and development expenditure and the breadth of customization options the product offers. It is widely acknowledged that the SAP ERP appeals more to large companies who can afford huge spending and need the sophistication of SAP's capabilities. The large costs of SAP's complex solutions can become a weakness if the client cannot justify them. Other vendors' strengths come primarily from a vendor's expertise or its leadership in introducing a specialized application. Oracle is noticed for its worldwide leadership in database (DB) sales and the strong financial position the company holds. Baan has the worst financial position, which comes from the continuous losses the company had been reporting. All the vendors were planning to offer CRM as part of the ERP suite except for J.D. Edwards, who established a partnership with Sieble, the world leader in CRM solutions.

The successful implementation of an ERP system is largely dependent on the selection of the ERP system and integrating it with the organizational business processes. It is therefore important to develop an understanding of the selection process of ERP systems in organizations. This study provides an exploratory investigation of the selection process of ERP systems in New Zealand. A framework describing the roles and involvement of different stakeholders in the selection process of ERP is presented below.

A FRAMEWORK FOR ERP SELECTION

This section examines the literature on stakeholder involvement in the development of information systems and information technology projects. This is a precursor for understanding the involvement of stakeholders in the ERP selection process. Previous studies on key issues in information systems research (Palvia, Rajagopalan, Kumar, & Kumar, 1996) and information management (Brancheau, Janz, & Wetherbe, 1996) show that key issues are changing and evolving over the years. Key issues can be classified as operational, managerial, and strategic (Palvia et al., 1996). The MIS triad model developed by Brookes (Brookes, Grouse, Jeffery, & Lawrence, 1982) can be used to develop a better understanding of the ERP implementation and its challenges within the organization. Three groups–top management, users, and IS personnel–are considered to be the internal stakeholders involved in the coordination. Issues identified in the previous studies are arranged according to this model with modification.

Top management has the authority to make the decision regarding policy questions and is responsible for the selection of projects. Brookes et al. (1982) suggest that the tasks for top management are fourfold. Table 5, provides a summary of the tasks for top management as well as other internal stakeholders involved in the selection of ERP.

Table 5: A sumary of the tasks of internal stakeholders involved in the selection of ERP systems

Internal Stakeholders	Tasks in selecting ERP
Top management	1. to set organization-wide objectives for ERP selection; 2. to specify criteria to be used for the ERP project selection and approval; 3. to review the implication of technical developments to ensure advantage is taken of them; and 4. to set up a mechanism to review regularly the effectiveness of current activities, specifying objectives and establishing procedures to ensure adequate communication within the enterprise.
Uses	1. to ensure that user requirements are met, to gain user commitment and to avoid user resistance; 2. to actively participate in project selection and approval of technical approach proposed by network designers; and 3. to improve understanding of the role and contribution of a technology such as ERP.
IS personnel	1. to provide necessary assistance to help top

Table 5: A sumary of the tasks of internal stakeholders involved in the selection of ERP systems

Internal Stakeholders	Tasks in selecting ERP
	management and users solve related problems; 2. to recruit and provide opportunities for career development of networking professionals; and 3. to develop understanding of the overall business operations.

Educating top management on the role of IS and its contribution as well as their involvement/support are of great importance for the successful implementation of IS (Brancheau et al., 1996; Choe, 1996; Choe & Lee, 1993; Palvia et al., 1996; Thong, 1996). Furthermore, top management, with a broader organizational perspective, is in the best position to identify business opportunities for the exploitation of IT, organization-wide IS planning, design, development, implementation and other activities (Thong, 1996). However, many cases of IS implementation failure result from the lack of knowledge by executive managers of the role and contribution of IS (Palvia, Zigli, & Palvia, 1992). Therefore, both issues–educating top management on role of IS and its contribution, as well as their involvement/support–need to be considered in the present study on the stakeholder involvement in ERP selection.

Users play roles as information system users, evaluators, and even developers in the implementation process. They also take part in the activities of project selection, approving the technical approach proposed by the system's designers, and management and control (Brookes et al., 1982). For the case of ERP selection, users may help to determine what efficiency is achieved in service delivery. This participation and involvement of users is encouraged to ensure that user requirements are met, to gain user commitment, and to avoid user resistance (Cavaye, 1995). At this point, sufficient education and training of users are strongly recommended. The training and education should not be limited to the IS application. Improving their understanding of the role and contribution of a technology such as ERP also needs to be given proper attention. Thus, issues related to users that need to be emphasized are user involvement/participation, educating users on the role and contribution of ERP, and educating/training users on ERP application.

Information Systems (IS) personnel are responsible for hardware and software installation and maintenance. They are also in charge of providing necessary assistance to help top management and users solve related problems. The rapid development of IT may lead to the shortage of qualified IS personnel (Palvia et al., 1992). Recruitment and career development of IS personnel must be taken into consideration for ensuring the success of ERP selection. Furthermore, training of personnel with software application skills is not enough today. To give better support for meeting the needs of a company, IS personnel also need to develop a better understanding of business operations (Palvia et al., 1992). Educating IT professionals on business knowledge is therefore addressed in this study. At this point, key issues related to IT personnel during the ERP selection process are: recruiting qualified IS personnel, retention and re-education of IS personnel, and acquainting IS personnel with business knowledge.

Companies frequently search for assistance from external experts when problems such as highly centralized organization structure and resource poverty are evident (Thong et al., 1996). Consultants and IT vendors can play a role as knowledge providers to lower

the knowledge barrier or reduce knowledge deficiency. Specifically, consultants can help in IS requirement analysis, hardware and software recommendations, and implementation management while vendors can provide suitable hardware and software packages, technical support and user training. Therefore, two more issues need to be included: enhancing vendor support and improving management consultation effectiveness.

To obtain the task of effective implementation, it is essential to achieve the participation, coordination and cooperation among all groups. Past studies on IS implementations suggest that effective communication is crucial for the successful implementation of any system (Brookes et al., 1982). Within the organization, top-down communication take place when information regarding IS policies on project priorities, project objectives, and selection criteria is passed from top management to users. Furthermore, information regarding budget policies, standards, and the predefined needs of senior management is passed to IS personnel. Bottom-up communication occurs while new users' needs and investment requests from IS personnel are reported to top management. Parallel communication between users and IS personnel is required to obtain the consensus of the demand and the supply. Communication between internal groups and external groups (vendor and consultant) could not be ignored either. Thus, achieving effective communication among all groups is another key issue during the selection of ERP.

THE PRACTICE OF ERP SELECTION IN NEW ZEALAND

It is observed for the case of ERP implementation that three parties–the client, the consultant and the vendor–are involved in both the selection and implementation. Primary data was collected through an interview with the ERP consultants, ERP vendors and managers in organizations implementing an ERP system. ERP systems included SAP, Oracle, Baan and J.D. Edwards. The interview lasted between 45 minutes to one and half-hours. In a few occasions, and because the face-to-face interview with the target informant could not be arranged, the interview was held on the phone and lasted between 10 and 15 minutes. Questions were open-ended and unstructured. Informants were encouraged to reflect on their experience of ERP implementation. One part of the study included a case study of ERP implementation in a health service provider organization, where the two perspectives of one operational manager and the implementation consultant were triangulated to develop the ERP selection and implementation story (Shakir, 2000). A finding of the ERP selection strategy in New Zealand is provided below. It is mentioned earlier that three parties–the client, the consultant and the vendor–are involved in the selection as well as the implementation of ERP. Figure 2 outlines the three main stakeholders involved in the selection and implementation of ERP systems.

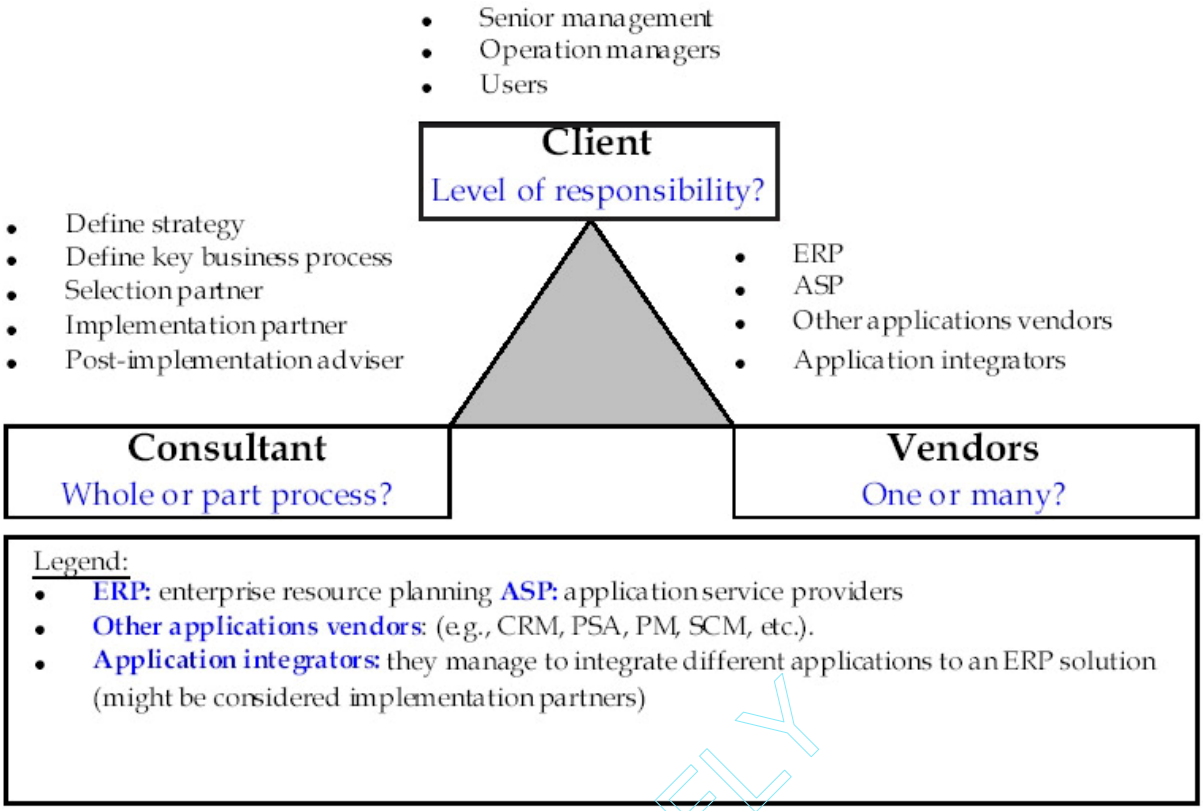

Figure 2: Stakeholders involved in the selection and implementation of ERP

Interview findings suggest that clients or companies intending to select and implement ERP usually request the bid for consultant. Each consultant or consulting firm intending to participate in the selection and implementation process of ERP is required to submit a detailed proposal highlighting recent research studies, have a discussion with clients to identify the key business processes (KBPs), and provide a guide or methodology to guide the selection process of ERP. In the process of identifying the KBPs, the consultant gets involved with business managers in developing contacts with other organizations in the same industries to provide an understanding of their ERP selection strategies.

New Zealand findings suggest that it is the responsibility of the consultant to invite the vendors to submit their proposal highlighting the price, functionalities of the software and demonstration of expected solutions. All three parties–the client, the consultant and the vendor–are involved in the solution demonstration phase of ERP selection. Once the solution demonstration phase has been completed, it is the responsibility of the consultant to guide the client through the short-listing process.
The process of short-listing is often iterative and the complexity and details of the process increase with the number of cycles involved. In the final decision to select an ERP, the consultant usually acts as a silent partner and assists the client with the decision to select if requested. Once the ERP offering of a particular vendor is selected, the client, the consultant and the vendor work closely for the implementation. All three parties are as well involved in the post- implementation phase of ERP. Figure 3 provides a generic model of the ERP selection process in New Zealand.

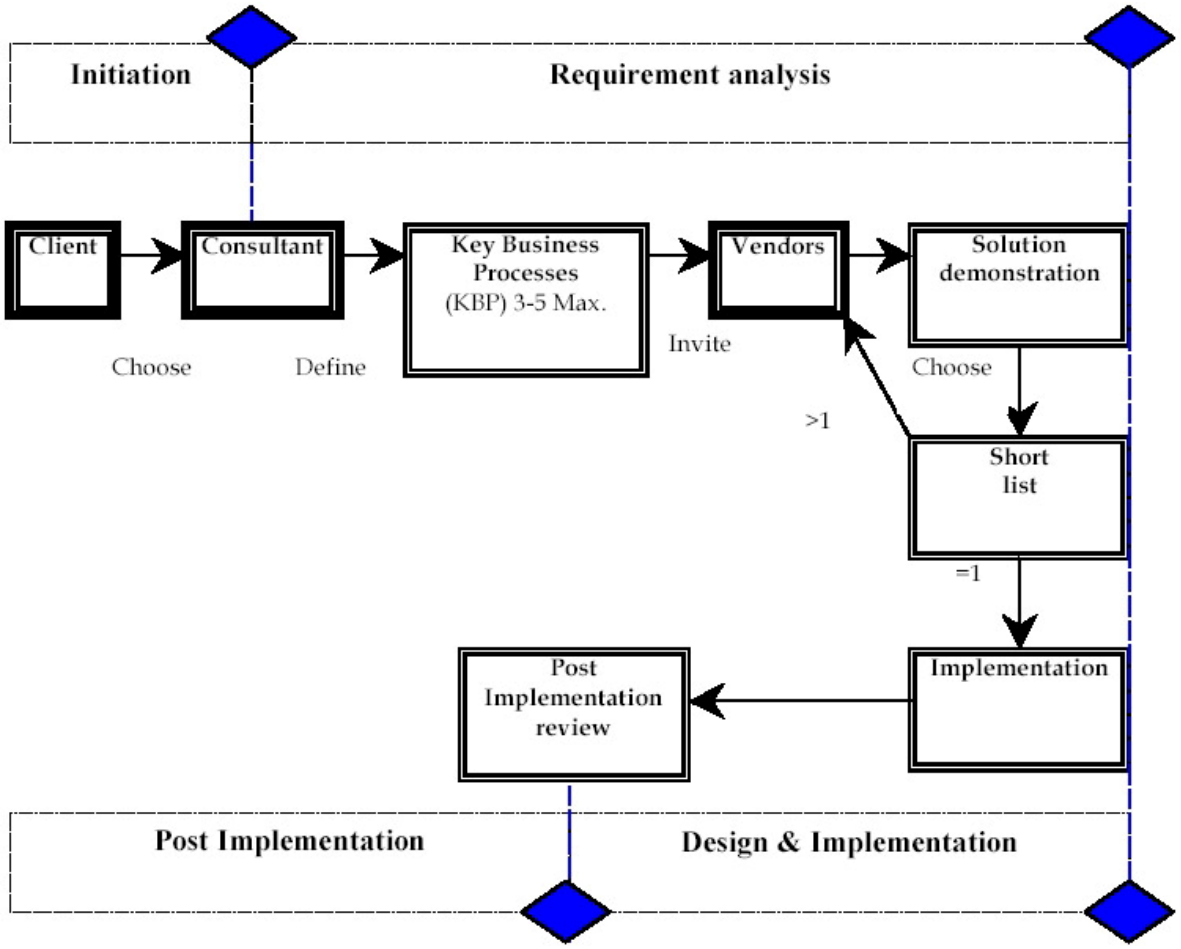

Figure 3: A generic model of the ERP selection process in New Zealand (Shakir, 2000)

CONCLUSIONS

New Zealand findings suggest that the ERP selection process is different from the selection process for other large IT investments as considerations for business processes are an integral part of ERP selection. It is also evident that most New Zealand organizations select their consultants and let them guide the ERP selection, implementation as well as post-implementation process. This IT outsourcing activity is increasingly becoming an important activity for maintaining and sustaining organisational competitiveness for most of the SMEs in New Zealand. It is also important to note that the increasing cost of ERP implementation as well as the post-implementation costs involved in the maintenance of a system are encouraging small-to-medium-sized organizations to move towards outsourcing as a survival strategy. This study also suggests that the best-of-breed strategy can easily be achieved through the adoption of selective outsourcing. The majority of the outsourced activities were IT infrastructure activities such as disaster recovery rather than IT development or IT strategy. The following IT outsourcing benefits are identified in relation to the ERP selection strategy adopted by SMEs in New Zealand–(i) cost reduction; (ii) in-house IT staff on more value-added IT work and business applications; and, (iii) improved flexibility of IT because the outsourcer's costs are more flexible than in-sourcing costs that are fixed. Other factors such as improved quality of service, improved use of IT resources, access to scarce IT skills, improved business flexibility, focus on core business, better management control, access to new IT, balanced processing loads, and help in cash problems were also evident from the findings.

ENDNOTES

1. The search was carried out on the 16th of June 1999 and covered publications dated 1997 till the end of May 1999. Search results for the "*Newzindex*" database resulted in 43 matching of 5,288,162 documents. Most of the matching titles were articles in *Computerworld New Zealand*. Search results for the "Newztext Newspapers" database resulted in 75 matching of 482,554 documents. Most of the matching titles were articles in *NZ Infotech Weekly*.
2. Oracle revenue calculated to a similar percentage of its 1998 revenue using the figures published by Enzweiler Group (1999). Oracle's revenue published on its Web site is $8,800 million and includes database sales as well as Oracle applications.

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Chapter XIV: Using Cost Benefit Analysis for Enterprise Resource Planning Project Evaluation: A Case for Including Intangibles

OVERVIEW

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The goal of this chapter is to demonstrate how cost benefit analysis can be applied to large-scale ERP projects and that these methods can incorporate the intangible benefits, e.g., user satisfaction. Detailed information on the business case utilized by a large computer manufacturer in their decision to implement the SAP system R/3 is presented. We illustrate how this organization utilized techniques to include intangibles in the implementation project's cost benefit analysis. The chapter concludes with a discussion on the state of valuing ERP projects and questions to be answered in the future.

INTRODUCTION

In 1998, expenditures for information technology (IT) accounted for more than 50% of corporations' annual capital investment in developed economies, and these outlays will average 5% of total corporate revenues by 2010 (Graeser, Willcocks, & Pisanias, 1998). Given the staggering amount of resources devoted to IT, $530 billion worldwide in 1995, one would expect managers to have a firm grasp of the anticipated contribution of their IT investments to the organization's profit margin. However, quantitative measurements of an IT project's expected return are not often used, primarily because they are unable to capture many of the qualitative and intangible benefits that are expected (Farbey, Land, & Targett, 1992). Still, managers must justify system investments, and hence "cost benefit analysis has assumed a pivotal position in the information systems revolution" (Sassone, 1988).

Information system project evaluation is challenging not because the projects cannot be justified but because they cannot be justified in terms which accountants and some senior managers are prepared to accept (Gunton, 1988). According to Mahmood and Szewczak (1999) the issue of measuring investments in IT is critical, these "measures may be quantitative in nature, but they must also be qualitative as well." The problem has grown as IS departments have advanced beyond implementing transaction processing systems, with returns that are relatively easily to quantify, to the implementation of management information, decision support and knowledge management systems. Systems in the latter category produce measurable benefits that are fuzzy at best and defy conventional methods for quantifying the benefits. The failure of traditional measures to adequately capture the true value of the information technology systems was observed in the early days of MIS as an academic discipline (McRea, 1970). This measurement dilemma has grown worse as IT becomes part of the organization's nervous system or infrastructure and is a critical part of its structures

and processes; where all elements are integrated assessing returns on individual assets is impractical. Moreover, such integrated systems will also be extremely valuable as repositories to aid in strategic decision-making. In addition to the factors listed above there is still a widespread lack of understanding of IT and information systems as a major capital asset (Willcocks & Lester, 1999).

In today's dynamic and competitive environment, senior managers are demanding figures that derive an IT project's return before the project is undertaken. Therefore, CIOs and their IT staffs are beginning to rely on both tangible and intangible measures to determine a system's contribution to an organization's bottom line. This procedure is a new endeavor for many IT staffs especially as they struggle to convert intangible measures such as user satisfaction to a tangible quantity suitable for inclusion in cost benefit calculations. This study examines Consolidated Computer Company's (CCC)[1] efforts to determine the contribution of a proposed enterprise resource planning (ERP) system they are seeking approval to implement.

The first part of the chapter presents a brief introduction to ERP systems, followed by a section where we define and discuss methods for evaluating IT investments and provide some detail on a family of techniques known as cost benefit analysis (CBA). We then discuss the wide range of intangibles that may enter into CBA calculations, which leads to the presentation of a method for including intangibles in a CBA setting. The latter part of the chapter presents a case study in which Consolidated Computer Company seeks to use CBA to justify the implementation of an ERP system and demonstrates how an intangible factor, user satisfaction, can be included in the analysis.

[1]The name is fictional, the company and case study are real.

ERP SYSTEMS[2]

Enterprise resource planning (ERP) is a term used to describe business software that is 1) multifunctional in scope, 2) integrated in nature, and 3) modular in structure. An ERP software solution is appropriate when an organization is seeking the benefits of business process integration and contemporary best practices in its information system, looking for a full range of functionality throughout its organization, and seeking to limit its implementation and ongoing support costs (Norris et al., 1998). Historically, the market for ERP solutions has been large multinational manufacturing companies (revenues over $1 billion) which operate in a discreet manufacturing environment. Today, however, the market is expanding to mid- ($250 million to $1 billion) and small-sized (under $250 million) companies across a wide range of industry sectors. The market is dominated by SAP-AG of Germany, which holds over 70% of the software market with their R/3 system.

ERP systems have their origins in manufacturing resource planning (MRP) software with installations traditionally in large-scale manufacturing facilities. However, recently the trend is to extend installations to industry sectors including telecommunications, government, insurance, gas and oil, and high-tech manufacturing. Firms implementing the software generally seek process-oriented increases in productivity, up-to-the-minute access to timely information, and cost-saving efficiencies. The systems are known for their process orientation rather than traditional functional orientation, and this may also enhance an organization's move toward breaking down departmental boundaries and thinking. The ultimate goal of many organizations implementing ERP packages is to carefully reengineer their processes, which in turn will hopefully benefit the bottom line.

Most ERP packages provide for a flexible organization structure with firms selecting which components they choose to use and how to implement them. Since the system is fully configurable, the organization turns on only those portions of the package it requires. The systems are designed with an open architecture, facilitating expansion for future modules and allowing bolt-on applications from their approved vendors. Currently, the packages are being enhanced with tools such as data warehousing, advanced planning and scheduling optimizers, executive decision support systems, and tools to enable electronic commerce.

The cost of implementing an ERP system varies. Approximate costs for implementations in smaller companies are $10 million, and the projects take an average of 23 months, with the total cost of ownership estimated at $15.6 million (Meta Group, 1999). In large companies, e.g., Fortune 1000, implementations can exceed several hundred million dollars and may take 5 years to accomplish. Yet, despite the considerable investment in time, capital, and resources the return on system investment is not clear. A survey of 63 companies with ERP systems discovered an average negative value of $1.5 million when quantifiable cost savings and revenue gains were balanced against spending on hardware, software, consulting, and support (Meta Group, 1999). Additionally, anecdotal evidence suggests that ERP failures have contributed to the bankruptcy of companies, e.g., Fox-Meyer Drugs (Bulkely, 1996). Yet despite negative reports such as the Meta Group's, ERP implementations are proceeding at a record pace with an abundance of success stories such as Cara Airport Services, which saved 7% on production costs after their implementation of J. D. Edwards' application (Stedman, 1999).

Given the growing expenditures required to implement large-scale systems such as ERP and infrastructure projects, senior management is demanding that chief information officers (CIOs) provide metrics to measure system contribution to the organization. CIOs are being counted on to deliver cost savings while adding competitive value as opposed to merely deploying systems. These managers are required to justify ERP investments through metrics while demonstrating that projects are satisfying business objectives. The use of metrics allows the CIO to show what business problems are being solved while providing evidence of the project's profitability.

The process of quantifying the value of IT projects becomes much more difficult as the scope and magnitude of projects grow. ERP system implementations generally require large capital investments and, because of their integrated nature, possess a wide and complex scope. Early business information systems were transaction processing systems (TPSs), designed to replace workers who performed repetitive tasks, e.g., payroll clerks. The determination of the costs and the benefits for these systems was relatively easy. The salary of workers to be replaced was compared against the cost of the system and hence the project's value was estimated. As systems became more complex and began to support other types of activities, e.g., decision making, the ability to quantify their payback became more difficult. It was clear that more and better information improved decision making, but it was very challenging to quantify the value of a better decision. Better decisions represent one form of intangible benefit derived from the IT system.

This process has become ever more complicated with the advent of large-scale projects such as ERP systems and other infrastructure technologies. In the case of infrastructure projects, the benefits in part are found in the services that they support and enhance. For instance, upgrading the telecommunication infrastructure could be measured in increased bandwidth or even how much faster files/ information is transferred. While

the improvements in these metrics are tangible, it is challenging to link their relationship to the monetary benefits resulting from increased market share as a result of a customer's repeat visits to an electronic commerce site. One of the ERP system's greatest benefits is its ability to integrate, standardize and provide real-time visibility to an organization's data. This benefit has been attributed to increasing productivity and improving management decision-making. Yet, given the task of quantifying this benefit, many organizations state that it is beyond their ability to measure and hence list it as an intangible.

[2]Additional information on ERP and SAP's R/3 can be found at www.sap.com or in one of many current business publications.

EVALUATION TECHNIQUES FOR TECHNOLOGY INVESTMENTS

In this section we briefly present a variety of techniques for measurement of technology investments and argue why a family of methodologies known as cost benefit analysis (CBA) is often the methodology utilized in practice. To determine the benefits of IT projects Wehrs (1999) differentiates between ex ante and ex post evaluation. In ex ante evaluation the focus is on justifying the IT investment before it is made, and in ex postevaluation the goal is to justify costs that have been incurred so as to guide future IT expenditures. In this chapter we are taking the ex ante view of the IT investment, that is, our goal is to focus on the investment decision and not the justification of costs already incurred from an IT project. Wehrs partitions ex ante analysis into three major sets of techniques: decision theory, user information satisfaction, and CBA.

Decision theoretic approaches include information economics (Parker & Benson, 1988) and multi-criteria approaches (Keeny & Raiffa, 1976; Land, 1976). In this class of approaches, the decision maker attempts to maximize the organization's utility or value function by taking the preferred action over the set of choices for the firm. Information economics sets out to rank or measure the financial impact of changes brought about by implementing the new information system. The multi-criteria approach measures the value of an IT project, perhaps in terms other than economic, and allows for appraisal of the relative value of different project outcomes. Both approaches allow for the advent of uncertainty and for the fact that different stakeholders may have different views on the benefits of the project. Implementation of this class of models is complex, requiring the specification of outcomes for the firm, the organizational utility or value derived from each outcome, and the potential actions available to the organization. In information economics one must also define the transition matrix, describing the likelihood of moving from one outcome state to another given the action taken. While both approaches have deep theoretical roots, they have been criticized by Kleijnen (1980a, 1980b) and Treacy (1981) for the extent of knowledge required by the decision maker to estimate model parameters and equations, the assumed rationality of the decision maker and the relative simplicity of this class of models in general.

The literature on user information satisfaction includes two major schools, user satisfaction and system use (Melone, 1990). Ives, Olson, and Baroudi (1983) introduce the concept of user information systems (UIS) as a method to evaluate IT investments by measuring the extent to which users believe the information system available to them meets their information requirements. UIS is accepted as a surrogate measure for changes in organizational effectiveness–the real goal of information system implementation. However, authors have criticized the UIS measure because of its lack

of theoretical basis and because of a lack of empirical work validating the relationship between subjective assessment outcomes and economic performance (Wehrs, 1999). According to Melone (1990), the literature on UIS indicates that, on its own, UIS cannot be a surrogate for effectiveness of an information system. Swanson (1988), on the other hand, argues that the user attitudes are measured because information systems exist for the purpose of serving client interest, and hence, individual assessments of information systems are held to matter.

Cost benefit analysis (CBA) has been widely utilized to compare the costs and benefits of all types of capital investment projects (Prest & Turvey, 1965). It seems to be the family of techniques most often utilized in calculating the economic value of IT projects (Bacon, 1992; Farbey, Land, & Targett, 1992). In all CBA approaches the future stream of economic benefits and costs is estimated and the value of each project option is calculated. One major benefit of the family of CBA approaches to managers is that the results are relatively easy to interpret, while the greatest challenge involves the adequate measurement of project costs and benefits (Brynjolfsson, 1993). Detailed lists of the set of methodologies that fall under the CBA umbrella can be found in King and Schrems (1978), Sassone and Schaffer (1978) and Sassone (1988). Because of the challenges associated with providing economic value for the costs and benefits in IT projects, Dos Santos (1991) has proposed a more complex IT project valuation model based on the idea that subsequent project investments are optional. The subsequent decisions can be made when additional information concerning project success has been revealed.

It is generally accepted that all CBA activities require estimates of costs and benefits in future time periods. These estimates should account for the relevant costs at each stage of the project or system's life cycle. Most authors (Hares & Royle, 1994; Sassone & Schaffer, 1978) make strong arguments for the inclusion of discount factors in CBA analysis. Additionally it is the consensus that proper implementation of CBA includes the use of marginal versus average value analysis and that careful sensitivity analysis should always be part of the process. The challenge of effective assessment of costs and benefits is at the heart of any CBA activity, and Sassone (1988) lists seven generic methods for accomplishing this task. Following the assessment of costs and benefits, one of a number of outcome measures is calculated. The most common measures include net present value (NPV), internal rate of return (IRR) and payback period.

The formula for computing net present value, NPV (Sassone & Schaffer,

$$NPV = \sum_{i=0}^{T} \frac{B_i - C_i}{(1+d)^i}$$

In this formula B_i and C_i are the values of the benefit and cost for the i^{th} period in the future and d is the discount factor. In this formula the NPV is calculated from the current period (time 0) until period T. A greater value for NPV is assumed to be an indication of a more desirable project. One principal criticism of the use of NPV as a criterion to judge a project is the choice of the discount factor, d. However, sensitivity analysis performed on this parameter will allow for examination of how the decision factor may affect the decision. In many cases, management will fix a value of d, known as the hurdle rate, for which the project must a have a positive NPV.

A second criterion that is often used is payback period. The payback period is simply the earliest period in which the project's cost is recovered. In using this criterion, it is

assumed that the project with the earliest payback period is the best. However, this may not be reasonable if a competing project has large anticipated benefits further in the future. A third method for evaluating projects is the internal rate of return, IRR, i.e, the annual rate at which the project is estimated to pay off. The quantity IRR is found by solving the following equation:

$$C_0 - B_0 = \sum_{i=1}^{T} \frac{B_i - C_i}{(1+IRR)^i}$$

If using IRR to compare project alternatives, one chooses the project with the largest value for IRR.

As mentioned previously CBA has been criticized on a number of fronts. Keen (1975) was the first to note that the many of the costs and benefits of information systems are challenging to measure. This challenge is heightened as the use of information systems moves from transactional towards strategic. Keeny and Raiffa (1975) and others have criticized CBA on the basis that it does not include a method of coping with the uncertainty that is usually present in information systems projects, e.g., many IT projects may be subject to user acceptance uncertainties. These criticisms make CBA challenging to utilize, however other authors have argued that this not evidence that CBA should be abandoned. Kaplan (1986) argues that one should choose a comparator, like missed strategic opportunity or declining cash flows, to compare information systems projects. Dos Santos (1991) argues that since IT investments are made over time, some decisions can be foregone until more information about project success becomes available. In either case, a project may then appear to be more valuable than it otherwise would have been had these factors not been accounted for.

Practically speaking, when financial analysis is called for, CBA is often utilized to analyze IT investment. Using CBA, Boehm (1993) found that the investment in software technology at the Department of Defense paid back $5 for every $1 invested. The Glomark Group (1996), with over 300 client companies, uses an ROI approach to assess the value of IT investments. Still, the issue of quantifiability seems to provide the major excuse for many organizations not to use CBA at all. Hogue and Watson (1983) found that in the case of DSS systems that a great majority (83%) of the organizations investigated did not bother to even try and quantify the benefits either in an ex post or ex ante setting. Farbey, Land, and Targett (1992) found that only 4 of 16 firms surveyed used any kind of quantitative analysis in estimating the value of IT projects. Bacon (1992) found that approximately 52% of companies used CBA approaches, but it was only applied to 56% of the projects within those organizations.

Sassone and Schaffer (1978) explicitly admit that costs and benefits of IT projects lie along a "spectrum of quantifiability" which makes the use of this procedure challenging. Hares and Royle (1994) agree and argue for the use of a broader methodology, "investment appraisal," which extends CBA to include discounting, the effects of over projects, project risk and flexibility and the inclusion of intangible assets. In the next section, we define and discuss classes of intangible assets that organizations may want to include in their CBA activities.

INTANGIBLES AND TECHNOLOGY EVALUATION

The new International Accounting Standard (IAS) 38 defines an intangible as an identifiable nonmonetary asset without physical substance held for use in the production or supply of goods or services, for rental to others, or for administrative purposes. In many areas, investment results in economically valuable, legally recognized intangible assets, including copyrights (*Titanic* and Windows2000), patents (Viagra), changes in processes for making existing goods, and other assets such as brand names and trademarks. If companies fail to include intangible assets or their marketplace results, then corporate profits are vastly understated (price/ earnings ratios are overstated), which in turn impacts national income, savings, and investment.[3] Intangibles can result in any combination of (1) a higher price for a premium product or service, (2) more sales from existing product or service, (3) cost savings from an existing or new product or service, and (4) new business/new sales from a new product/service (Hares & Royle, 1994).

Not every business goal or benefit from a project can be quantitatively measured. A recent Ernst & Young (1999) study found that information not quantified on a company's balance sheet is increasingly becoming an important criterion for potential investors. Nonfinancial criteria, such as quality and credibility of management, market share, quality of investor relations, and customer satisfaction, accounted for 35% of the investor's decision. Davidow (1996) indicates that in the information age four-fifths of a firm's assets are intangible and that double- entry bookkeeping and measures of return on investment which do not consider intangibles are understating corporate value and profitability. Lev (1997) also indicates that conventional accounting performs poorly with internally generated intangibles, e.g., R&D, brand names, and talent, which are considered the engines of modern economic growth. Hares and Royle (1994) suggest that none of the methods for CBA are able to show how to measure and value the intangible benefits in financial terms.

Historically, the different treatment of tangibles and intangibles can be traced to the distinction between goods and services. As far back as Adam Smith, goods were material and could be stored while services were immaterial and transitory. This transitory nature meant services could not be counted as assets, but goods could. Logically, then, things counted as investment must be tangible. This led to a definition of wealth as "material objects owned by human beings." Therefore, what is material is tangible and can constitute wealth, which underlies the national income accounting conventions used to determine asset value, profit, saving, and investment. This logic fails to consider that more investments in today's economy are intangible, and these investments yield higher profits, which equal greater output and savings. One estimate suggests that an adjustment for R&D alone would raise US GDP roughly 1.5%. Extending this argument to project evaluation, the payback period would be reduced, and the return to the business would become proportionally greater.
Annie Brooking suggests that IT cannot be measured in isolation. In her book, *Intellectual Capital,* she indicates that there is a shift in the makeup of the net value of a company. In 1977, 1% of the net value of a UK company was based on intangible assets. In 1986 the make up shifted to 44% and it is growing rapidly. She decomposes intangibles into four areas: market assets, items which yield market power, e.g. brand names; intellectual property–copyrights; human-centered assets like knowledge; and infrastructure assets. IT falls into the last category. It is not the value of computers and software in the business, but their impact on the business' performance. Brooking examines Barclays bank, whose computer and software assets equal approximately

£100million. If those assets suddenly disappeared, the bank would not open, so clearly the value of the assets is much greater than the cost of the assets themselves. The difference is their intangible benefit or worth. The knowledge and expertise of an information technology department is an intangible asset in and of itself, but so is the way IT applies that knowledge to make other departments function more smoothly (Schwartz, 2000).

Computer systems are increasingly being developed for what are at first sight non-price factors and hence intangible. Hares and Royle (1994) indicate there are two main intangible benefits in IT investment. The first is internal improvement or infrastructure investment and the second is related to customers. The latter, customer-viewed intangible benefits are overwhelmingly those that the customer sees now and wants in the future–particularly related to customer service and user satisfaction (See Figure 1). These qualities possess an intrinsic value potentially greater than the immediate and calculable financial returns. They categorize intangible benefits as ongoing and future-oriented.

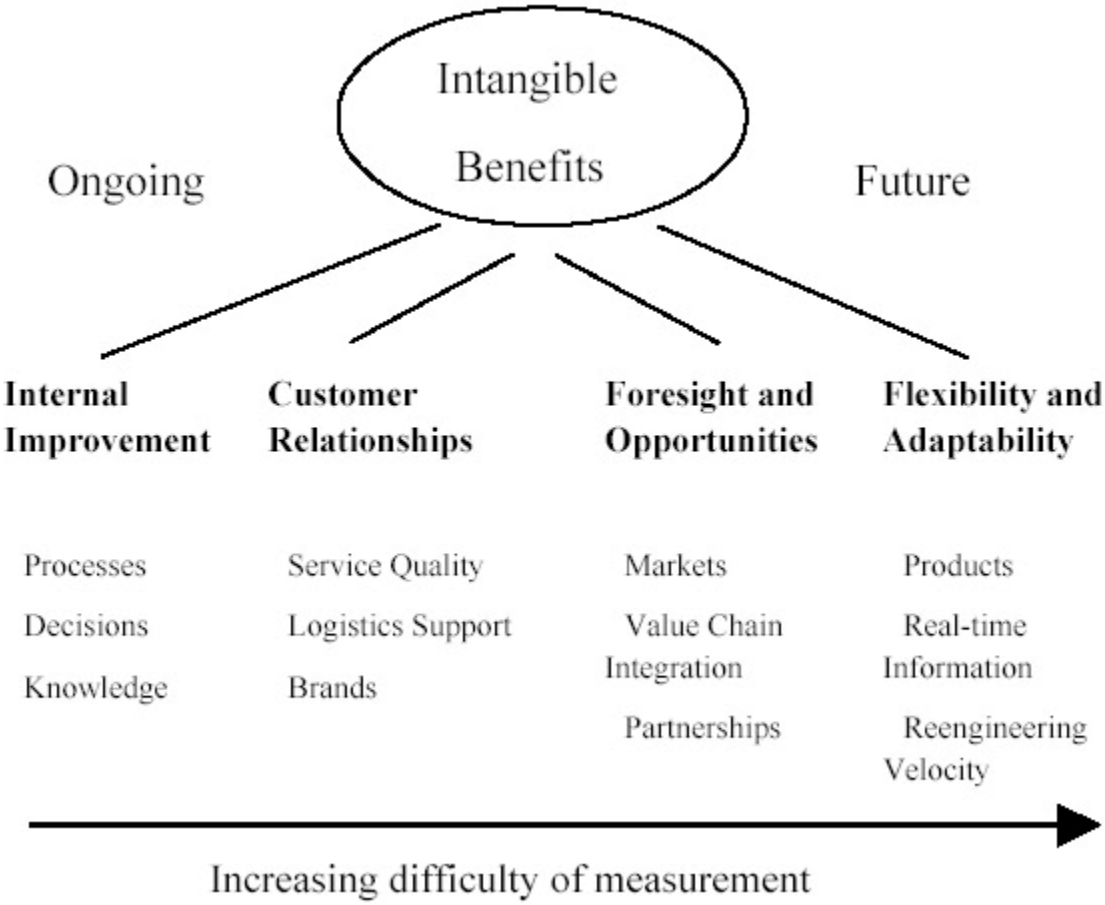

Figure 1: What are intangibles?

The ongoing intangible benefits are those concerned with internal improvement of company operations or output performance. These are perhaps the most tangible of intangible benefits and can include 1) changes in production processes, 2) methods of management operations, and 3) changes to production value and process chains with resulting benefits as increased output or lower production costs. The second group of intangible benefits is more difficult to measure, with their effectiveness being decided by external forces. This grouping involves services to customers that increase the utility

(value added) of products or services. The benefits are converted into retained sales/customers, increased sales, customer satisfaction, and increased prices and include 1) quality of product or service as a market differentiator, 2) improved delivery of a product or service, and 3) improved service provided with products and services.

The next two groups of intangibles relate to future benefits and include the ability to identify new business opportunities, leading to competitive advantage. The first of these benefits embodies spotting market trends. If new trends can be ascertained then a business is able to convert products or services to gain new sales and market position. Another example of this intangible benefit is the development of processes through which to conduct business operations. This method provides the opportunity to cut prices and gain market dominance as was the case with Dell Computers. The final group of intangible benefits is the ability to adapt to change. As with the identification of market trends the benefits derived include adapting products and services to market trends and the modification of production processes. This ability is critical for firms in rapidly changing industries and can potentially be converted into increased sales and higher margins.

IT projects deliver intangible benefits that cannot be quantified using mathematical equations like NPV, such as better information access, improved work flow, and increased customer satisfaction (Emigh, 1999), which are listed among the key attributes of ERP systems. One key function of IS departments has been the support of high-quality decision making. This has been difficult to quantify, especially at the higher levels of the organization where results are deferred. In the IS literature, Davis (1976), Emery (1971), and Keen and Scott-Morgan (1978) point out the importance of intangible benefits. Litecky (1981) indicates that despite the perceived importance of intangibles, there has been little if any guidance in the quantification of derived benefits. He proposes several assumptions as a precondition to quantifying benefits. First, tangible costs and benefits are relatively easy to estimate whereas intangible benefits are quite difficult to estimate. Second, tangible costs are ordinarily much greater than tangible benefits, and intangible costs are insignificant.

Parker and Benson (1988) explain that in order for enterprises to gain competitive advantage, the way IT is financially justified must change. Cost benefit analysis is not adequate for evaluation of IT applications, except when dealing with cost-avoidance issues. If CBA is to be expanded, additional measures such as the perceived value to the business, increased customer satisfaction, or the utility of IT in supporting decision-making must be considered (Katz, 1993). Clark (1992) found little guidance on IT's contribution to corporate profits in the literature but found reliability of service, technical performance, and business plan support, all items difficult to accurately quantify. Other studies found varying measures of IT assessment including productivity (increases of), user utility, impact on value chain, business alignment (Wilson, 1988), system quality, information quality, use, and user satisfaction (DeLone & McLean, 1992). Accampo (1989) contends that CBA can be hard to apply to activities where information is the key commodity. Given that many of the measures found in the IS literature and listed above to evaluate system success are intangible, traditional methods of project evaluation fall short. This problem becomes even more difficult when analysis encompasses changes to business processes and information flows which impact productivity and decision support.
A survey conducted by Ernst & Young (1988) found that 60% of all UK companies concerned with the manufacturing of automobile components made no attempt to quantify the intangible benefits gained from the use of CAD/CAM systems, that only 20% quantified the benefits in physical terms, and only 20% quantified the intangible

benefits in monetary terms. To accomplish the task of incorporating the intangible benefits into the financial analysis one must create multi- attribute justification techniques which permit the inclusion of both monetary and nonmonetary factors in the analysis (Badiru, 1990). This method can lead to a single financial model but requires a technique that bridges the gap between the intangible and tangible factors. Illustrated in Figure 2, this quantification technique (Hares & Royle, 1994) applies a set of steps to express intangibles in monetary terms. The steps include 1) identify benefits, 2) make the benefits measurable, 3) predict the results in physical terms, and 4) evaluate the cash flow. As will be explained, this technique strives to convert the intangible benefit into cash flow that can be incorporated into CBA.

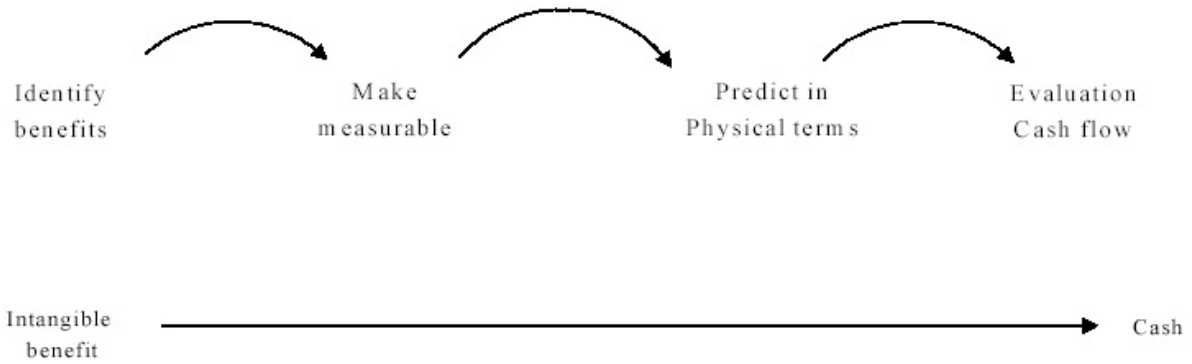

Figure 2: The quantification technique "bridging the gap"

The first step of quantification is the *identification* of the intangible benefits. Two useful sources of information to assist identification include 1) critical success factors (CSFs) and 2) a checklist of intangibles. Many CSFs include quantifiable items. For instance, improved customer service, a CSF, could be measured by a stated reduction in the number of customer complaints. A checklist of intangibles is generally easier to create but perhaps harder to quantify. The IS literature suggests a number of factors for evaluating system success including customer satisfaction, product/service quality and reliability, speed of service, improved service, and reduction of errors. All of these intangibles can be converted into monetary terms through the ability to 1) maintain and increase sales, 2) increase prices, 3) reduce costs, and 4) create new business.

The second step is to make the intangible benefits *measurable*. This consists of reexpressing the benefits described above in more measurable terms. The third step is to *predict the benefit in physical terms*. This is generally the most difficult of the quantification steps, with multiple methods to convert measures into actual numbers. The first method is the market survey. Market surveys are most attractive because 1) the perceptions of the company and customer can be aligned and an agreement of monetary equivalence can be agreed upon and 2) surveys can include a forward-looking component which could lead to proactive actions which potentially increase the value of the project. The second method is management estimates, which is usually used when surveys are not possible. Senior management, whose operations are supported by the project but who are removed from project responsibility, generates these estimates. The problem with management estimates is that they are based on past evidence and therefore reactive. The third method is comparative case study of a similar business. The advantage of this method is that the firm gains from the lessons learned from the past exercise. The disadvantage is that past projects are conducted in a different business environment, and the method uses backward-looking methodology. The final step in the quantification technique is the *evaluation in cash flow terms*. This is a simple mathematical process with the volumes from the previous steps related to the

monetary value of the benefit. It is at this point that the technique can be merged with CBA.

[3]For instance, Titanic sold $1 billion in theater tickets and Viagra sales exceeded $700 million in its first month.

THE BUSINESS CASE FOR ERP AT CONSOLIDATED COMPUTER COMPANY

Consolidated Computer Company (CCC) is a global software and hardware manufacturing, distribution and consulting organization with a long and very successful history delivering and implementing a wide range of business solutions. In the early 1990s CCC faced very significant challenges that included high operating costs, a bloated workforce and many redundancies across the globe in manufacturing, research, and design. To revive its legacy, CCC set forth a number of strategic imperatives that included firm-wide cost reduction, reduction of product development and deployment cycle, marketing as a single global organization and streamlining the relationship between CCC and its customers. One part of implementing the plan for accomplishing these objectives was to put in place the integrated supply chain in its personal computer division (PCD) which would include procurement, production and fulfillment.

In examining the costs of operating the company, among other items, CCC's corporate management found that IT expenditures were excessive. Like many other multinational organizations CCC had, over the years, implemented and now operated hundreds of nonintegrated information systems to support their business throughout the world. Management felt that reduction of a number of legacy systems could be achieved through the use of an integrated software solution, i.e., an ERP system. To accomplish their goal of reducing costs and integrating the supply chain, corporate managers established a relationship with a major ERP solution provider. While corporate management moved ahead with the new initiatives, the operating problems at PCD were only getting worse.

In 1993, the management of PCD had authorized significant expenditures on new parts in anticipation of strong sales. Customer dissatisfaction with product stock outs had been on the rise for some time, and using strategic procurement PCD management hoped to prevent this from reoccurring. When sales of certain models did not reach expectations, the outdated procurement and inventory systems were unable to stop the flow of parts from vendors, increasing inventory levels sharply. Across the globe each production facility was operating its own applications and systems for supporting supply chain processes, which made it impossible to coordinate purchasing and inventory management activities. This crisis, which resulted in heavy operating and bottom line losses, made a massive restructuring of PCD division an imperative. For the personal computer division the reengineering would entail removing many redundant elements and replacing fragmented information systems with integrated solutions.

At the beginning of 1997, managers in charge of reengineering the supply chain in PCD were directed to justify the large expenditure that would be required to implement the ERP system. To cut costs in operations PCD's management believed that decreasing work in progress and increasing inventory turns in the production facility were necessary. One part of achieving these goals included the implementation of a just-in-time procurement system. Improvements to the order fulfillment and customer management processes would also be required to improve declining customer

satisfaction indices. Furthermore, it was clear that the large number information systems used in operations did not offer the functionality required to attain these goals. To justify the substantial investment, the CBA methodology was utilized to build the business case for implementing the ERP solution.
The scope of the PCD systems implementation project was to bring the ERP solution to three major production facilities across the globe. In their analysis PCD management used NPV, IRR and payback period to assess the project's return on investment. The business case was built assuming a 10-year time horizon utilized a 20% hurdle rate. To calculate benefits, very conservative revenue growth and profit margin assumptions were made and no benefit was assumed to commence until 1 year following the implementation at each site. Productivity savings of between 5 and 20% were assumed for the production and order fulfillment processes. The new system would also enable a onetime inventory reduction of 10% that was assumed to occur 1 year after implementation. Cost savings resulting from the reduction in number and complexity of systems in operation were also included. Major capital expenditures were assumed to occur over 3 years, and the high end of development and deployment cost estimates were used for each site. The cost benefit estimates resulting from the above assumptions are shown in the Table 1.

Table 1: Cost Benefit Analysis (Tangibles Only) NPV($ millions)/IRR

Productivity	Inventory	IT Operations	Implementation Cost	Total*	IRR*
18.8	49.1	23.4	(73.4)	28.1	39.20%

* Additional factors are included in these figures

INCLUDING INTANGIBLES IN THE BUSINESS CASE

PCD management utilized calculations with several intangible items in building the business case, including customer satisfaction. In this example, only customer satisfaction will be used, simplifying the illustration. Customer satisfaction was selected since CCC's management indicated that of all the intangible items it had the greatest potential impact on project evaluation.

Long before PCD embarked on their ERP evaluation project the company's managers knew there was a serious problem with customer satisfaction. Their annual surveys of customers and suppliers indicated that levels of satisfaction were down 21% and 15%, respectively, with customers indicating significantly better relations with PCD's competition. Realizing that sagging satisfaction would soon translate into smaller market share and falling profit margins, senior management ranked satisfaction improvement as a key goal during system evaluation. Using a method very similar to the quantification technique of Hares and Royle (1994), the project managers identified improved customer/user satisfaction as a key system deliverable.

Satisfaction as a deliverable was critical to customers and suppliers and existed as a metric within PCD, with data collected on an annual basis. To convert satisfaction from an intangible to a measurable factor, PCD's IS department compiled a list of customer-reported system deficiencies from the last satisfaction survey. Upon completion of the deficiencies list, IS managers examined each item's performance in the current system

and its expected result on the proposed ERP system (see Figure 3 for a sample of the items). This procedure established a baseline from which the managers could project the level of satisfaction improvement once the proposed system was in place. From the proposed improvements, managers throughout PCD, not just members of the project team and IS department, consulted customers and projected that once deployed the proposed ERP system could improve customer satisfaction by 5% initially and approximately 2% per year thereafter (assuming system performance expectations were met).

Item	Current System	Proposed ERP system
Enter pricing data	5-80 days	5 minutes
Committed ship date	1 day	Real time
Schedule orders	Overnight	Real time
Credit check	15-20 minutes	Real time
Enter order	30 minutes	5 minutes
Inquiry response	15-20 minutes	Real time
Ship and build	Overnight	Real time

Figure 3: Sample items for customer satisfaction survey

The next major task in this analysis was to predict the economic value of an increase in customer satisfaction to CCC. This step was also accomplished through management interviews and surveys with CCC's key customers and suppliers.

The managers undertaking this project were those most familiar with customers, particularly those in the sales and marketing organizations. The results of several hundred interviews suggested that for each 5% improvement in customer satisfaction, CCC could expect a 1% gain in market share. The results, while nonscientific, indicated that market share increases would result in significant benefits for the company. The final step of this process was to evaluate the potential cash flow resulting from market share gains. Based on the cash flow resulting from the customer market share improvements the CBA was redone and the results appear in Table 2 below.

Table 2: Cost Benefit Analysis (Tangibles and Intangibles) NPV($ millions)/ IRR

Productivity	Inventory	IT Operations	User Satisfaction	Implementation Cost	Total*	IRR*
18.8	49.1	23.4	228.7	(73.4)	228.9	124.00%

* Additional factors are included in these figures

DISCUSSION AND CONCLUSION

In the face of significant threats to market share and shareholder value, the Consolidated Computer Company (CCC) embarked on a major organizational restructuring. As part of that effort, the personal computer division (PCD) was asked to justify in economic terms a large investment in an ERP solution. In the first cost benefit analysis (Table 1), PCD management used estimates of productivity savings, inventory savings and savings resulting from more effective information systems operations to calculate the net present value (NPV) and internal rate of return (IRR) for the project. The NPVs of productivity improvements and inventory reductions resulting from new

system implementation were estimated at $18.8 million and $49.1 million, respectively, over the 10-year time horizon. The NPV for IT operations cost savings was estimated to be $23.4 million. The total NPV for the project was estimated to $28.1 million and all NPV calculations assumed a 20% hurdle rate. Table 1 shows that the internal rate of return for this project was estimated to be 39.2%. Using these estimates the ERP implementation project appears to meet the hurdle-rate criteria set by CCC management.

In a subsequent CBA many of the same cost and benefit figures were utilized, however, the intangible item of customer satisfaction was also included. The assumption made by PCD management was that implementing the ERP system would have a significant and positive impact on customer satisfaction and hence improve market share. This view had been justified by data gathered through customer interviews. The NPV resulting from increasing the customer satisfaction was estimated to be $228.7 million. This resulted in the new total NPV of the project when customer satisfaction was included in the project to be valued at $228.9 million with an IRR was 124%. Upon including the intangible of customer satisfaction the ERP implementation project was significantly more beneficial to improving organization bottom line.

CCC's managers reported that at the inception of evaluation, the company's senior management sought an economic analysis oriented towards immediate bottom-line returns. The evaluation team reported some of their concerns that potentially could skew short-term oriented analysis. Their concerns included: 1) long implementation lead times; 2) large initial investments for hardware and software; 3) increasing frequency of changes in technology; and 4) shortages of skilled technically knowledgeable personnel and knowledge workers. The evaluation team also raised a number of issues that influenced decisions that were beyond the range of quantification but impacted the project's acceptance. A sample of these issues include: 1) IS departments limited control of technology budgets, 2) dynamic and complex technology cycle, 3) socioeconomic and socio-technical factors, and 4) organization politics. As a result of the successful evaluation and awareness of the related issues listed above, CCC's senior managers were better prepared to evaluate the project, able to reorganize organizational priorities, and view the system's contribution holistically. Therefore, the decision to implement the ERP system was not based completely on numerical evaluation of tangibles and quantified intangibles, but on more substantial issues such as market position, growth potential, benefits to customers, product effectiveness, and of course, profitability.

As a result of the evaluation and analysis, CCC's IS department was given the approval to implement the enterprise resource planning (ERP) package. The implementation of the new system, including replacement of legacy hardware and software, was conducted on time and on budget. During its first year of operation the ERP system contributed over $225 million in savings and productivity improvements. The results of the CBA and intangible analysis were convincing factors that led CCC to the decision to implement the system. Without the numerical results senior management would not have agreed to move the project forward regardless of anticipated benefits. Even with the analysis of tangible factors and the quantification of intangibles, all benefits of a large scale IS project are not included in the overall equation.

The first and most important criteria when undertaking IS project evaluation is whether the system contributes to the strategic objectives of the organization. This initial criteria is more complex than "does the system help the organization achieve its goal" or make the organization better at what it does. One benefit often cited upon installation of an

ERP system is the improvement in information quality, access, and use. Benchmarking Partners (1999), a research and technology advisory firm, reported 88% of respondents in the banking and finance industries cited information quality and accessibility as a key benefit of their implementation. Janus Capital Management found that their finance group spent 65% of their time tracking down data so that analysis could be conducted. Their implementation cut storage costs, improved efficiency, and decreased time to provide clients with information. In addition to accessibility of information, quality and standardization of information rank high on the list of strategic benefits. Most ERP systems replace a number of legacy systems, each with their own databases and data formats. The ability for management throughout the organization to understand data while having it in a standard format, located in a single database, improves the quality of the information in turn leading to better decisions.

Movement to enterprise integration and process orientation was also cited as a key strategic benefit. This benefit is manifest in the breaking down of organization barriers, previously represented in departmental structures, and replacing them with integrated optimized processes. Standardization of an organization's technology platform is another benefit area. Similar to the situation for business processes, many organizations have found themselves with widely disparate IT platforms, systems, and data standards throughout their organizations. As a matter of fact, the Y2K problem prompted many organizations to replace old legacy systems. While there is no guarantee that replacing legacy systems is cheaper in the long run (there is actually some debate regarding total cost of ownership with ERP systems), in many situations new systems are easier and cheaper to maintain than their predecessors.

Most of the benefits discussed above can be grouped under the category of keeping the organization competitive. Some of the costs and benefits, e.g., system operations and maintenance, are easily measured. Others, such as better access to information, information quality, and improved decision making are harder, if not impossible, to quantify. The managers at CCC made a conscious decision to measure some factors and omit others due to time and fiscal constraints. They also made all their assumptions based on the worst case scenario. All estimates and numerical justification were made using the most conservative estimates. This allowed them to report confidently to senior management knowing their results reflected the most realistic findings and expectations.

The future will bring about an even greater need to focus on intangibles when justifying systems implementation projects. The projected economic value of process and systems integration efforts will need to be measured not only on internal projects, but also across suppliers, customers and other partners in the value chain as business to business electronic commerce becomes more prevalent. The value of information that will be available in data warehouses, from knowledge management and executive information systems will be another challenge for managers performing ex ante systems implementation analysis. A cohesive set of methodologies and techniques to measure the value of these intangibles will be required if management is to succeed in better estimation of project value.

Information systems' escalating expense and growing importance to organizations have made the justification of projects increasingly critical. This study demonstrated that traditional cost benefit analysis could be applied to large-scale information systems projects such as infrastructure and enterprise resource planning. Extending the traditional methodology, the study illustrated how intangible measures can be used to augment CBA analysis and include what was once believed not considered measurable.

This improved analysis provided CCC's managers with a more accurate and realistic look of the returns expected as a result of undertaking the ERP implementation.

ENDNOTES

1. The name is fictional, the company and case study are real.
2. Additional information on ERP and SAP's R/3 can be found at www.sap.com or in one of many current business publications.
3. For instance, Titanic sold $1 billion in theater tickets and Viagra sales exceeded $700 million in its first month.

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Chapter XV: Effective Use of External Expertise in Enterprise Systems: A New Zealand Case Experience

OVERVIEW

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Enterprise systems (ES) are large, complex highly integrated information systems designed to meet the information needs of the organization. Limited research has been conducted on the use of external expertise in information systems and virtually none as it applies to enterprise systems. This paper addresses the issues associated with the use of external expertise in enterprise systems. It looks at the ES implementation life cycle and identifies where in the implementation process external experts are utilized and what roles they fulfill in the implementation project. The paper concludes with a New Zealand case experience illustrating the use of external experts in a major enterprise systems implementation.

INTRODUCTION

Enterprise systems (ES), a more general and comprehensive term than the more focused enterprise resource planning (ERP) term, are large, complex highly integrated information systems designed to meet the information needs of the organization. Davenport (2000) describes these systems as information systems that integrate information from all functional areas of an organization with the goal of providing a more whole or complete information resource. An extension of prior large-scale integrated systems, i.e., manufacturing resource planning (MRP II), enterprise systems have become essential for large multinational corporations wishing to integrate and standardize their organization's business processes. Now, small to midsized organizations are adopting enterprise systems to remain competitive in the global marketplace. Most organizations wishing to fully implement an electronic commerce (e-commerce) strategy recognize the need to integrate the Web-based front-end of e-commerce with order fulfillment, logistics, and financial back-end systems supported by the enterprise system (Marchak, 2000). Thus enterprise systems have become the foundation that supports an organization's eCommerce strategy.

Enterprise systems (ES) are large, complex beasts. (See Table 1 for a summary of ES implementation characteristics.) Enterprise systems typically require millions of dollars in resources, years of focused commitment, and a large contingent of highly skilled professionals to ensure successful implementations. Most organizations struggle with ES implementation (Baldwin, 2001; Markus & Tanis, 2000; Wagle, 1998). Even with the financial resources and the long-term focused commitment, where do organizations find the required expertise to successfully implement these complex systems? The answer is often to engage external experts, i.e., consultants, to fill this resource void. The use of consultants (also referred to as integration partners) is common in ES implementations (Abramson, 1998; Davenport, 1998; Markus & Tanis, 2000; McCarty, 1999; Ross, 1999). The issue becomes not whether an organization should use external expertise, but rather how to effectively engage and utilize external expertise.

Table 1: Summary of ES implementation characteristics

Enterprise Systems Characteristics
▪ Large ▪ Complex ▪ Integrated ▪ Expensive ▪ Long implementation cycle

Limited research has been conducted on the use of external expertise in information systems and virtually none as it applies to enterprise systems (Brown & Vessey, 1999). Thong, Yap, and Raman (1994) published one of the few empirical studies on the use of external experts in information systems. They studied the level of IS effectiveness in small businesses using a consultant-vendor approach to information systems implementation versus a vendor-only approach.

They concluded that small businesses that adopted a vendor-only approach achieved a higher level of IS effectiveness and a higher level of organizational impact than small businesses that pursued a consultant-vendor approach. Their findings were based on input from 57 small businesses in Singapore and did not address the issues associated with complex integrated systems such as enterprise systems. Ironically, virtually everything written in the area of external expertise use is from the major consulting firms and software vendors who are providers of the external expertise.
Recent studies (James & Wolf, 2000; Markus & Tanis, 2000) suggest just how significant implementation and consulting services are in enterprise systems implementation (see Figure 1). These studies indicate that total investment in ERP systems was $82 billion in 1999. The largest of four expenditure categories was implementation and consulting services ($38 billion), almost double the cost of hardware or vendor software. Studies suggest that implementation and consulting services are between two and five times ERP licenses' cost (Markus & Tanis, 2000). Projections are for ERP licenses revenue to increase to $67 billion by 2003. If the relationship between software license revenue and implementation and consulting revenue continues, the projected cost of implementation and consulting services for enterprise systems implementation will be between $138 billion and $335 billion by 2003, a huge number!

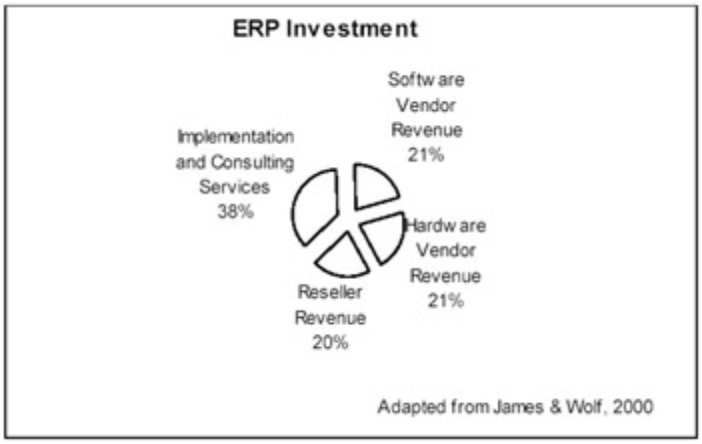

Figure 1: Summary of ERP investment

This paper addresses the issues associated with the use of external expertise in enterprise systems. It looks at the ES implementation life cycle and identifies where in the implementation process consultants are utilized and what roles they fill in the implementation. The paper concludes with a New Zealand case example illustrating the use of external experts in a major enterprise systems implementation.

EXTERNAL EXPERTISE ISSUES

The decision to engage external experts in the ES implementation project is significant. (Often, it is the external expert who first proposes the use of an enterprise systems approach–but more on that later.) The selection of an external consulting partner is a long-term commitment to the consultant's philosophy, methodology, and culture. The relationship generally spans 5 years or longer and cost millions of dollars. Mistakes in the selection of external experts are difficult and expensive to correct.

External Expertise Fit With Organization

A key issue in the selection of ES consultants is a strong cultural fit between the organization and the external experts. Where does the expertise reside, with the organization or with the consultant? How accommodating is the consultant in adapting to the ways of the organization? Or, must the organization adapt to the methodology of the consultant? Does the consultant propose a "proven" methodology that is acceptable to the organization? What is the position of the organization relative to project involvement? Hands-off–let the consultants do everything and tell me when we're finished–or, active involvement with the organization, having a strong need to understand the processes and be directly involved in the decision process. Fit is critical to the success of the relationship between the organization and external experts. It is also a key ingredient for overall ES success (McCarty, 1999).

Alternatives for Engaging External Experts

There are various alternative strategies to engaging external experts in an ES implementation project. These alternatives are outlined in Table 2. When and in what role external experts are initially involved in the ES implementation process varies widely. It depends on the needs and internal expertise of the organization. Most organizations follow one of two dominant strategies in engaging external experts. The

organization either initially selects the ES software vendor or initially selects an ES consulting firm to provide guidance and early direction for the project.

Table 2: Alternatives to engaging external experts

Alternatives to Engaging External Experts
▪ ES Software Vendor, Integration Partner ▪ ES Consultant, ES Software Vendor ▪ ES Consultant, ES Software Vendor, Integration ▪ Partner ES Consultant, ES Software Vendor, Integration ▪ Partner, ES Auditor

In the first strategy, the organization selects the ES software vendor and then chooses the external experts, i.e., integration partner. The organization has recognized the need for an ES solution, evaluated the marketplace, and chosen a primary ES software product. This decision drives and influences the need for engaging external experts. The primary role of the external expertise is to support the implementation of the selected ES software. In this mode, the ES software vendor often recommends (or influences the decision on the use of) the external experts to the organization. The ES software vendor may fill the role of external expert itself by providing implementation expertise and support.

The second strategy is where the organization first selects the ES consulting firm and involves these experts in the review and adoption of the ES software vendor. In this mode, the external experts have a much more significant role in ES decision processes. They not only impact the implementation of the ES but also key decisions relating to business processes, organizational objectives, and change management. Organizations that adopt this strategy may recognize a need for an ES solution but lack the internal expertise to evaluate alternatives and make informed business decisions without the support of trusted partners.

A third strategy becoming more prevalent is a hybrid that involves the use of multiple sources of external expertise. The firm engages an ES consultancy to assist in ES vendor evaluation and selection. It then, with the assistance of the ES consultant, chooses the ES software vendor. The selection of the ES software drives the organization to select a different integration partner to assist in the ES implementation. The organization must now manage multiple sources of external expertise. This arrangement can lead to conflict and confusion if the roles of the various external resources are not clearly defined and managed. This multi-resource strategy recognizes the specialized needs of a complex ES implementation and facilitates the overall ES change process.

A fourth strategy is an extension of the third, adding an additional source of external expertise to conduct post-ES-implementation review. The role of ES auditor is becoming more common, especially in large ES implementation environments. These external experts seek to evaluate the business value of the ES implementation, determine if goals and objectives were accomplished, and verify/ validate the outcomes of the implementation. Where used, they are virtually always an independent resource that was not engaged in the ES decision process or the implementation. There is very little

role conflict between the ES auditor, the ES consultant, or the integration partner. The ES auditor generally reports to the chief executive officer or board of directors of the organization and provides an objective evaluation of the ES project.

EXTERNAL EXPERTISE USE IN ES IMPLEMENTATION

The utilization of external expertise varies across the implementation process. Figure 2 provides a model of the use of external expertise in the ES implementation process. This model breaks the ES implementation into four distinct phases: pre-ES, early ES, mid-ES, and post-ES. Each phase will be discussed separately.

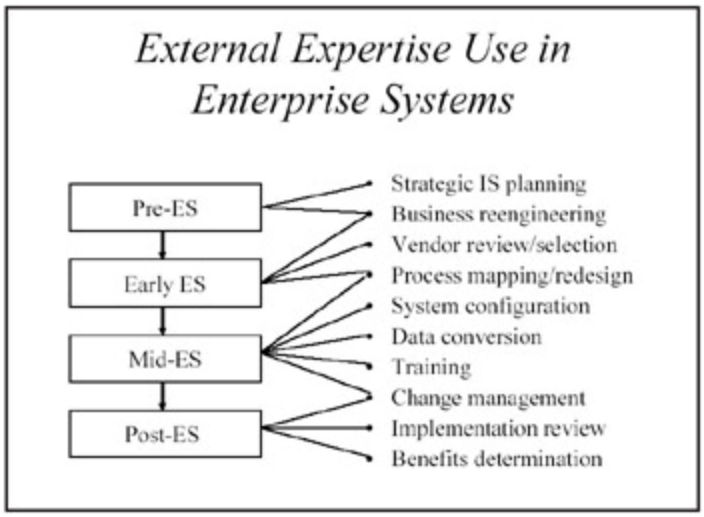

Figure 2: Use of external expertise model

Pre-ES Phase

The pre-ES phase involves the use of external expertise prior to ES being considered by the organization. Generally, this is in the form of strategic management consulting or strategic IS planning. As organizations review and prepare their strategic IS plans, it is common to engage external experts. These consultants provide a valuable resource that often identifies the need and makes the initial suggestion that the organization should consider an ES as a possible solution to organizational information needs.

Another role of external experts in the pre-ES phase is in the area of business process reengineering. During the past decade businesses have begun to carefully evaluate their business processes and make necessary changes to streamline these processes. As business processes change, so must information systems that support them. Organizational options remain limited; the business either builds totally new information systems to support their new business processes or adopts an ES solution to support the necessary change. Davenport (2000) discusses at length the role of ES in enabling business process reengineering. Many organizations choose to adopt an ES and then adapt their business processes to fit the ES, preferring organizational change to software modification and subsequent software maintenance concerns.

Early ES Phase

As organizations begin the process of evaluating and adopting an ES solution, the roles of the external experts change. If the organization has opted to engage ES consultants prior to the selection of the ES software vendor, the external experts can provide multiple valuable services. These include, but are not limited to, business process reengineering; business case development; software vendor analysis, review, and selection; and process mapping and redesign.
It is apparent from Figure 2 that there is an overlap in the roles of external experts as we move through the ES phases. Business process reengineering (BPR) can occur prior to the ES decision and/or during the ES project, beginning in the early ES phase. Often the ES project is driven by the BPR initiative as previously discussed. Where an ES solution is adopted, there will be process change. The need to map existing processes and then design/redesign new processes is a fundamental requirement of ES implementation (even the socalled technical ES implementations require some business process modification). External experts often fill a major role in the area of process design/redesign. Many organizations lack the internal expertise and experience to complete this critical task without assistance.

Another key area of ES consultant involvement is in the development of the business case. In order to ensure business value, the organization should develop a comprehensive business case for the adoption of the ES solution. This business case should provide a statement of purpose, project goals and objectives, project scope, and a cost/benefit analysis of the ES proposal. The business case clearly defines the baseline that will be used to evaluate the success of the ES implementation, as well as metrics to be used in the post-implementation review. Again, organizations often lack the internal resources needed to complete the task independently.

The final area we discuss in the early ES phase is software vendor analysis, review, and selection. ES consultants are often engaged to assist the organization in identifying qualified ES software vendors, providing a methodology for analysis and review and assisting in the software vendor selection process. ES consultants often have keen insights into potential software vendor solutions. Gaining experience from multiple engagements, the ES consultant often enjoys a better perspective of what is available in the ES marketplace and which of a variety of software products best meets their client's needs. A solid relationship with an ES consultant can facilitate the review and selection process and avoid the pitfalls of the novice organization. Most organizations have never dealt with a software purchase decision of this magnitude or complexity. The availability of competent expertise can prove invaluable.

Mid-ES Phase

Mid-ES is the heart of the implementation process. The ES software vendor has been selected, the hardware requirements have been determined (based on the software requirements), and the database/network infrastructure necessary to support the ES is in place or being implemented. There are substantial needs for skilled resources to accomplish multiple critical tasks, both technical and nontechnical. It is at this phase that most organizations find they lack the internal expertise to complete necessary tasks in a timely manner. Thus organizations often turn to external experts to assist in the ES implementation.

Generally the external experts in this phase are referred to as integration partners. They provide unique expertise on the ES software and implementation methodologies.

The ES software vendor may provide this resource through its consulting/implementation support organization. Some vendor support will likely be included in the ES software agreement, but it is unlikely to meet all the needs of the organization as the organization works through the implementation process. Most organizations find themselves contracting for additional services from their ES software vendor and/or a third-party ES consulting firm.

There are a number of tasks that could, and often do, involve external experts. Process redesign is ongoing and spans the early ES phase. Additionally, organizations seek assistance in configuring the ES to the organization, planning and executing the data conversion, developing and delivering the necessary training, and supporting the overall change management process. There are certainly other roles and responsibilities, but these appear to be the dominant roles that are filled by external experts.

The role of the external expert is both technical and nontechnical. ES configuration requires the mapping of the organization's business processes into the ES software, or the adapting of the organization's business processes to the ES capabilities. In either case, business processes must be mapped and adjusted to meet the needs of the organization. Business processes, and organizations, must change. External experts often play key roles in business process mapping and change management.

Training and education have long been identified as essential to information systems success. Most organizations lack the internal expertise necessary to develop and deliver an effective ES training program. Thus, organizations again turn to external resources. ES software vendors provide courses and training focused on their specific products. Often, however, this training is generic and not adapted to the organization's business (or even culture). Customized training provided by third-party organizations fills a need in this mid- ES phase by developing and delivering training and education tailored to the organization's needs. Case studies indicate that training must provide both the detailed functional training and the overall context/framework of the ES (Avital & Vandenhosh, 1999; Hirt & Swanson, 1999; Ross, 1999). If users do not understand their role in the ES, they will not be able to effectively utilize the system.

Software installation and conversion is a critical point in the ES implementation process. The methodology used for ES conversion varies with organizational size and complexity. Alternative installation approaches include big bang, phased, incremental, or a hybrid approach (Davenport, 2000; Markus & Tanis, 2000). External experts provide the experienced insights into the overall conversion process. Having gained experience from multiple ES implementations, the integration partner can suggest strategies and techniques to minimize risk and maximize results. A combination of external experts and internal organizational resources offers the best source of knowledge and expertise at this critical stage.

Post-ES Phase

The final phase of the ES implementation process recognizes the need for ongoing change management, ES implementation review, and value/benefits determination. Though an ES project is never complete, it does reach a point where reflection and evaluation is essential. Given the investment in time, commitment, and resources necessary to implement an ES, business value must be realized and results documented. Post-implementation consultant review provides such an objective analysis.

The goals and objectives established in the business case in the early ES phase must be revisited, metrics updated, and business value determined. External experts are best suited for such a review. Reporting to the CEO or board of directors, the ES consultant should be independent of the implementation process itself, not having participated in earlier project phases. The ES audit should identify and document the return on investment of the ES project. ES solutions are business solutions and must provide business value. In order to justify and support ongoing investment in future systems, current systems must deliver value. This value can best be verified though the use of external experts.

Another component of the post-ES phase is the ongoing support for and upgrades to the initial ES solution. As ES software vendors offer new releases of their products, organizations must plan and implement, as appropriate, these new releases. Change is constant; the organization operates in a dynamic environment and must continuously adapt to these changes. The ES must continuously change to keep pace with organizational and environmental changes. External experts may be useful in assisting the organization in the continuous change management process. It is important to note that a technical change to an ES without business value is ill-advised. If the change does not provide business value, don't do it.

A NEW ZEALAND CASE EXPERIENCE

The following discussion describes the experiences of a major New Zealand organization as it implemented an ES solution. The company made extensive use of external experts during its 5-year implementation project. The organization's name and certain company information have been altered to protect its identity. Information was collected in 2001 from interviews with key organizational managers and company records. Table 3 provides a summary of the organizational information.

Table 3: Major industrial organization

Product/Service	Commercial/consumer
Business Scope	International
Revenue	$1.5+ billion
Employees	10,000+
Project Scope	Broad, multifaceted
Project Focus	Comprehensive ERP
Project Sponsor	CFO
Project Cost	$75+ million
Number of Users	2,500+
ES Vendor	SAP
ES Consultants	Multiple
Time Frame	5 years
Project Benefits	Operational benefits

Major Industrial Organization (MIO) is a New Zealand multinational corporation with over $1.5 billion (NZ$) in sales. It manufactures commercial and consumer products for the Australasian market. One of the leading industries in New Zealand, MIO has long played a key role in the nation's economy. MIO has multiple strategic business units (SBU) exploiting opportunities in targeted market segments. These SBUs operate semiautonomously, having profit and loss responsibility but requiring corporate approval for budgets and major capital expenditures.

Prior to the ES, the information systems of MIO were a loose federation of distributed, quasi-independent systems. Consolidation was difficult and required extensive manual intervention. Information was not integrated or shareable across the enterprise and business processes varied widely. Over 35 different financial applications ran on more than 50 platforms spanning Australasia.
MIO had a corporate culture of utilizing external experts to aid in strategic decision analysis. A long-standing relationship with their financial accountants made the use of consultants a natural extension to support information systems. Boston Consulting Group (BCG) provided MIO with strategic IS consulting in the early 1990s. BCG assisted in developing strategic information systems plans and reviewing strategic information systems decisions. During their work, BCG discovered that one large SBU was exploring the use of an ES to meet its information needs. BCG evaluated the proposal and recommended that the board of directors support the proposal and that an ES solution be considered as a corporate strategy. Table 4 provides a summary of the use of external expertise during the ES project. The table maps the case use of external expertise into the external expertise use model presented in Figure 2.

Table 4: MIO use of external expertise

Pre-ES	
Strategic IS planning	Boston Consulting Group
Business Case	
Early ES	
Vendor review/selection	IBM
Process mapping/redesign	Ernst & Young, Deloitte
Mid-ES	
Systems configuration	Ernst & Young, Deloitte
Data conversion	Ernst & Young
Training	SAP
Change management	Ernst & Young
Post-ES	
Implementation review	BCG, McKinsey
Benefits evaluation	Authur Andersen

Pre-ES Phase

In 1994, working with its primary systems vendor, IBM, a large SBU evaluated the ES marketplace in New Zealand and found virtually nothing. There were no ES software

vendors with a New Zealand presence. There were no identifiable ES implementations in New Zealand. Australia provided the closest access to this emerging technology. The chief financial officer (CFO) of the SBU championed the investigation and a small evaluation team recommended the adoption of SAP as the ES software vendor. An extensive evaluation was not conducted. IBM provided the initial external expertise and substantially influenced the decision process. BCG's subsequent review and endorsement raised the scope of the project from the SBU level to the corporate level.

With support from BCG, the corporate CFO became the enterprise sponsor for the ES initiative, Spirit. Funding for the project was approved in late 1995. The CFO of the originating SBU was made the project director, reporting to the corporate CFO. A small core project team was organized. Almost immediately, the project director and CFO recognized that they were embarking on a journey with little experience or internal expertise and began to evaluate the use of external expertise.

Early ES

The ES software vendor selection was completed with no formal ES consulting advisement. MIO adopted the strategy of selecting the ES software vendor and then considering the use of external expertise to assist in ES implementation. Though a common strategy, it often precludes a thorough ES vendor analysis. IBM did provide guidance and input early in the decision process but did not participate in a formal consulting relationship. They did, however, exert considerable influence in the decision process and guided MIO to review and evaluate SAP.

Business process inconsistencies across SBUs had created problems for MIO. The enterprise was struggling with consolidated information needs, especially in the financial area. One of the goals of the ES was to standardize many of these business processes. To assist in business process mapping and design, MIO engaged two major consulting groups, Ernst & Young and Deloitte. At the time, there was limited expertise in New Zealand to assist MIO. The decision to engage two major consultancies was based on the need to gain as much expertise as quickly as possible and to evaluate the skill sets and experience base of these two competing firms. Unfortunately, in the mid-1990s neither firm offered substantial experience in ES implementation and had to rely on imported expertise from Singapore and the United States.

The experience proved challenging, with conflict arising between the two competing consulting groups. Each group of consultants had its own culture and methodology. Neither was willing to adapt to the other and MIO was caught in the middle. At the height of consultant involvement more than 40 external experts were working at MIO. The consultants would engage other consultants in an attempt to expand their influence and increase their experience base. MIO found itself paying excessively for services it perceived as having limited value. As it moved into the mid-ES phase, MIO reevaluated its strategy for utilizing external expertise.

Mid-ES Phase

While continuing to map business processes and make necessary adjustments for the new ES environment, MIO began the configuration of the SAP system. Configuration support was received from SAP, Ernst & Young, and Deloitte. Key MIO project personnel attended multiple SAP training sessions and found representatives from their integration partners attending the same training. This knowledge precipitated a change in the scope and utilization of external expertise. As contracts expired, they were not

renewed. MIO focused on identifying key expertise and either hiring the individual or contracting specifically for a known resource. They quickly reduced the number of consultants involved in the project to about seven (from five to nine, depending upon the project requirements). External experts became coaches and mentors, assisting MIO staff in completing necessary tasks and providing guidance and insight as the project developed.

An extensive multisite environment, MIO used a phased approach to implementing SAP. SBUs were independently configured to meet their specific needs. No standard configuration was imposed. SBUs had considerable latitude on which modules to adopt, though all generally adopted a core set of financial, inventory management, and sales order management modules. The only requirement was they must use SAP and they must support corporate consolidated reporting requirements. Where business processes differed across SBUs, the SBU was required to justify its uniqueness by demonstrating the business value derived. If successful, the SBU could continue the unique business process. Changes to SAP were made at the SBU level to support unique business processes. This created considerable differences among SBUs and a major support challenge as more SBUs came online.

A core implementation team was formed to aid SBUs through the conversion process. The team was composed of corporate Spirit staff, external experts, and SBU staff. An SBU implementation required approximately 6 months. Core financials could be live in half that time. Each implementation phase required configuration, training, data conversion, go-live, and support. The greatest challenges were in the massive data conversions necessary to get an SBU operational in a short period of time.

MIO used a hybrid implementation methodology developed from its experiences with multiple consulting partners. It included a five-stage approach with a focus on quality assurance. Each SBU would verify its readiness for conversion to SAP by demonstrating competencies in more than 30 areas. External consultants played a key role in the quality assurance effort by evaluating the readiness of the SBUs. If readiness could not be demonstrated, the conversion was delayed.

Training was an integral component of the implementation methodology. The Spirit team provided most of the training with assistance from SAP. Taking a train-the-trainer approach, each SBU identified key users/champions for each functional area. These individuals received training by the Spirit team and in turn provided training to their SBU colleagues with the support of Spirit staff. The training included both detailed "how to" training and conceptual "why" education so that users would understand how their work fit into the organization's strategy for an integrated system.

Early SBU conversions were understandably rocky. As experience was gained, MIO developed a knowledge base of issues and resolutions. The knowledge base, maintained in Lotus Notes, provided a key resource for subsequent conversions and ongoing support. As the project evolved, later SBU conversions went smoother with fewer surprises.

Change was managed internally by the Spirit team and corporate and SBU management. Training was conducted prior to each SBU implementation. Strong corporate support for the ES solution and demonstrated benefits overcame limited resistance. External expertise was used in a limited role, primarily in the quality assurance area discussed previously.

Post-ES Phase

As the SAP implementation progressed towards successful completion, MIO conducted a number of independent reviews to ensure the project was on track and delivering business value. BCG provided an initial external review in late 1996 when they validated the overall ES deployment. McKinsey reviewed the ES project structure, progress and benefits realization in 1998. Authur Andersen, however, conducted the most comprehensive external review.

Andersen conducted a best practices review of the financial functions initially in 1995, pre-ES. They then conducted a follow-up review in 2000, post-ES. Their assessment confirmed the business value of the ES solution at MIO. The following results were confirmed:

- Sales/profitability benefits through margin improvements
- Production savings through improved yield/less scrap
- Purchasing savings through consolidation, pricing, and process efficiency
- End-of-month close reduced from 15 to 3 days
- Head-count reductions at SBU and corporate levels

Summary

MIO utilized external expertise extensively throughout their ES project. At every phase they engaged one or more external resources. Though not always a perfect relationship, MIO gained substantial benefits from the use of external expertise. As early adopters of ES in Australasia, MIO pioneered many of the methods required for successful implementation. Their consulting partners were transferring expertise into New Zealand from other areas of the globe and learning along with MIO as the implementation progressed. MIO in turn learned how to effectively engage external experts during the implementation.

Lessons learned from the MIO experience include:

- Strategic consulting during the pre-ES phase was helpful in defining project scope and promoting corporate acceptance of the ES solution.
- Use of multiple consulting groups during early and mid-ES phases caused conflict, proliferation of consultants, and limited value added.
- Focused use of external expertise during mid-ES phase added substantial value to the project.
- Benefits validation by external experts during post-ES phase confirmed project returns and provides basis for future systems enhancements.

CONCLUSIONS

This paper has discussed the issues associated with the use of external expertise, i.e. consultants, in the implementation of enterprise systems. It provided a basis for the importance and extent of the use of external expertise in the market. Virtually all organizations implementing an ES use external experts to some degree. Studies suggest that the costs of consultants are two to five times the cost of the license fees for the ES software (Markus & Tanis, 2000) and will exceed $100 billion (US$) by 2003.

The paper then explores strategies for engaging external experts. Four alternative engagement strategies are presented and discussed. Alternative ways of utilizing

external experts are identified and reviewed. The ES project is broken into four phases and the use of external expertise is discussed for each phase. A model for the effective use of external expertise is proposed.

The paper concludes with a New Zealand case experience of a major industrial organization's ES implementation. The case is mapped into the proposed model and lessons learned from the case are presented.

The use of external expertise in enterprise systems is essential for project success. Only in effectively utilizing this expertise can organizations realize their ES goals and objectives. More work must be done in order to more fully understand this critical element in enterprise systems implementation.

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