

Enterprise Resource Planning Solutions and Management

Fiona Fui-Hoon Nah Ph.D
University of Nebraska,
Lincoln, USA

IRM Press
**Publisher of innovative scholarly and professional
information technology titles in the cyberage**

Hershey • London • Melbourne • Singapore • Beijing

Acquisitions Editor: Mehdi Khosrow-Pour
Managing Editor: Jan Travers
Assistant Managing Editor: Amanda Appicello
Copy Editor: Amanda Appicello
Cover Design: Tedi Wingard
Printed at: Integrated Book Technology

Published in the United States of America by
IRM Press
1331 E. Chocolate Avenue
Hershey PA 17033-1117
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@idea-group.com
Web site: <http://www.irm-press.com/>

and in the United Kingdom by
IRM Press
3 Henrietta Street
Covent Garden
London WC2E 8LU
Tel: 44 20 7240 0856
Fax: 44 20 7379 3313
Web site: <http://www.eurospan.co.uk/>

Copyright © 2002 IRM Press

All rights reserved. No part of this book may be reproduced in any form or by any means, electronic or mechanical, including photocopying, without written permission from the publisher.

Library of Congress Cataloguing-in-Publication Data

Enterprise resource planning solutions and management/[edited by] Fiona Fui-Hoon Nah.
p. cm.
Includes bibliographical references and index.
1-931777-06-3

(paper)

1. Production planning. 2. Manufacturing resource planning. I. Nah, Fiona Fui-Hoon, 1966-
TS155 .E44 2002
658.5--dc21 2002017320

eISBN: 1-931777-26-8

British Cataloguing-in-Publication Data
A Cataloguing-in-Publication record for this book is available from the British Library.

About the Editor

Fiona Fui-Hoon Nah is an Assistant Professor of Management Information Systems at the University of Nebraska-Lincoln. Previously, she was a member of the faculty at Purdue University. She received her Ph.D. in Management Information Systems from the University of British Columbia. She is currently serving on the editorial boards of *Information Resources Management Journal*, *Journal of Database Management*, *Journal of Global Information Management*, and *Annals of Cases on Information Technology*. She has published in journals such as *Communications of the ACM*, *Journal of Information Technology*, *Journal of Information Technology Cases and Applications*, *Journal of Computer Information Systems*, *Journal of Software Maintenance*, *Business Process Management Journal*, and *Simulation and Gaming*. One of her recent works titled, "SAP Implementation at the University of Nebraska," that was published in the *Journal of Information Technology Cases and Applications* (Volume 2, Number 1, March 2000), presents the issues and challenges faced by the University of Nebraska in its implementation of SAP. Currently, she is looking at researching the organizational and technical issues in implementations of enterprise resource planning.

Foreword

ERP AND ITS EVOLUTION

Enterprise Resource Planning (ERP) refers to large commercial software packages that promise a seamless integration of information flow through an organization by combining various sources of information into a single software application and a single database. Although ERP has its roots in more primitive applications, the turn of the century has seen an explosion of research, debate, and information about its evolution and place in the business world. The outcome of ERP itself is still a mystery, but the trends and issues it has created will be the enigma that future generations will have to solve.

Today, businesses are striving for integration. Organizations are also transforming their processes to meet demands by becoming more flexible, adaptable, and efficient. Not only is accurate and up-to-date information needed, success in business today entails a seamless flow in supply chain, excellent customer relationship management, and capabilities to carry out electronic commerce. Traditionally, separate units were created within an organization to carry out various tasks, and these functional areas would create their own information systems thereby giving rise to systems that were not integrated. ERP strives to provide a solution to these problems.

HISTORY OF ERP

In the 1950s, large manufacturing companies produced Material Requirements Planning (MRP), which was created to keep track of all products and materials across one or more plants, and was also used to keep track of needed materials. Two decades later, MRP was extended in the software application called Manufacturing Resource Planning (MRP II), which not only processed the material portion of the equation, but also the planning process. Taking into account the production schedule, amount of resources available, and other planning requirements, MRP II was a step beyond its predecessor.

Both MRP and MRP II were created with the manufacturer in mind, but ERP is more than a material and scheduling application package. ERP software packages are designed to integrate information used by all the functional areas of a business into a single database to streamline business processes for an enterprise. The promise of integration and the benefits that it could produce, coupled with the approach of the new millennium and the Y2K scare, made ERP the most heavily invested software package in the 1990s. Unfortunately, many who tried to implement these packages had to face a much harsher reality.

PROBLEMS IN ERP IMPLEMENTATION

Many businesses encountered numerous problems when trying to implement the massive systems. The packages not only cost large amounts of money, but the processes to implement those systems often ran over budget because of hidden costs. This, however, was the first of many issues in ERP implementation. Other risk factors include failure to redesign business processes to fit those set out by the software, lack of top management support or a "champion," insufficient training and inclusion of the end-users during and after implementation, inability to recruit and train qualified ERP systems developers, insufficient data standardization, lack of integration across all functional areas of a business, and failing to obtain and keep expert knowledge of the system. Much research attention has focused on both understanding these issues and identifying ways to solve these implementation problems.

ERP FOR SMALL- AND MEDIUM-SIZED COMPANIES?

Small to medium ranged businesses are also looking for integration solutions. PeopleSoft, Baan, and SAP have structured quick implementation and training packages to relieve the problems that larger companies have fought. The vendors are also allowing these companies to outsource parts of ERP software, because smaller firms may not be able to support the entire package by themselves. Further, vendors have modified their software into components, allowing clients to easily install portions of an ERP suite and to have accelerated implementation time. This has helped vendors to cater to small to mid-ranged companies. With a nearly saturated ERP market for large businesses, ERP vendors are extending their software to provide a total business solution.

FUTURE OF ERP

ERP has opened up a world of other opportunities. Third party vendors are beginning to fill the gaps left by ERP systems. These vendors are another factor of competition that has made ERP developers rethink their products. Siebel Systems, for example, has become a leader in the field of Customer Relationship Management (CRM), which has close ties to ERP. I2, on the other hand, is providing solutions for Supply Chain Management (SCM). ERP vendors today have been focusing their energies on creating better ways to operate with CRM, SCM, and collaborative packages in their suites. Many who have already invested heavily into ERP, however, are looking to complement their systems to boost their strategic position in the markets. Thus, ERP for these companies is being used as a backbone for the upcoming software packages, and ERP's evolution is being pushed by these technologies to improve on areas such as CRM and SCM.

The extension of these software packages does not stop there. ERP had been solely focused on the back-end integration of a business in the past, but after the Y2K scare the market for ERP software took a turn for the worse. Businesses began to focus on the front-end portion of their organization, the end that dealt with customers and business partners. Many analysts had surmised that the Internet would be the end of ERP, but businesses quickly came to realize that ERP was not going away. In fact, advent of e-commerce could only be complemented by the back-end integration supplied by ERP. Today, many of the traditional vendors are scrambling to engineer their products to support a Web-based platform. With continuing integration with web-based applications, security has also become a major issue.

CONCLUSION

The evolution of ERP has seen its technology spread outward from the internal functions to different areas, and the term ERP II has been coined to encompass the expanding definition of what ERP is. ERP II is being defined as a software package that will use components to integrate business functions. Although this is not a new concept in itself, ERP II focuses on inter-operability between ERP systems and the modules themselves. This will enable businesses to connect their separate ERP systems. Also, XML is helping to create meta-data standards for databases and applications alike to communicate with one another, which will help integrate separate units and their external activities.

Even amidst all of these issues, ERP continues to survive and adapt. Software developers and third party vendors will continue to push and evolve the massive software packages. Even though ERP was traditionally focused around manufacturing, its expanding functionality will continue to take an important place in the future of business.

Preface

Enterprise Resource Planning systems are key to optimizing organizational performance; however, choosing which system to implement, when to perform the implementation, and how to minimize costs while maximizing system acceptance are all important issues to businesses considering an ERP implementation. As the business world focuses more upon e-business and incorporates the Internet into daily business transactions, ERP systems have to be able to keep up with the e-business world, but this requires modifications. Business leaders seeking to understand or implement ERP systems and researchers and academics seeking access to the most recent technological advances, need to have access to the most current research and practice concerning Enterprise Resource Planning systems. The chapters in this book provide up-to-date case studies and theoretical discussion of ERP systems and are a must-read for anyone considering an ERP implementation or desiring to improve upon an already existing ERP system. The authors, all renowned for their expertise in the field of ERP systems represent a diverse cultural and organizational background and share their insights in the following chapters.

Chapter 1 entitled, "[ERP + E-Business = A New Vision of Enterprise System](#)" by Betty Wang and Fiona Fui-Hoon Nah of the University of Nebraska-Lincoln (USA) discusses the importance of having an Enterprise Resource Planning (ERP) infrastructure in place when beginning to do business on the Web. The authors look at the best practices consisting of real-time, cross-enterprise Internet based flow of information documents and processes which requires the constant development and deployment of new e-business models.

Chapter 2 entitled, "[e-ERP: A Comprehensive Approach to e-Business](#)" by Colin Ash and Janice Burn of Edith Cowan University (Australia) reports on the results of research carried out over the last two years on the state of e-business developments within ERP environments worldwide. The authors used structured interviews to collect data in two stages: organizations from Australia and organizations from around the world. The results indicate that facilitators in e-business change management, including cultural readiness, knowledge and learning capabilities, are recognized by organizations, but their incorporation varies greatly among organizations.

Chapter 3 entitled, "[The Evolution of ERP Systems: A Historical Perspective](#)" by Mohammad Rashid of Massey University-Albany (New Zealand), Liaquat Hossain of Syracuse University (USA) and Jon Patrick of the University of Sydney (Australia) 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, supply chain management and other extended modules and integration with the Internet-enabled applications.

Chapter 4 entitled, "[Towards an ERP Life-Cycle Costs Model](#)" by José Manuel Esteves of the Universitat Politècnica de Catalunya (Spain), João Alvaro Carvalho of the Universidade do Minho (Portugal) and Aldemar Santos of the Universidade Federal de Pernambuco (Brazil) describes an exploratory study that identifies costs related to ERP systems during their life-cycle. The authors define and categorize the various costs and categorize the costs as tangible or intangible. The chapter also puts forth a case study where costs related to the three initial phases of the life-cycle are analyzed.

Chapter 5 entitled, "[The Myth of Integration: A Case Study of an ERP Implementation](#)" by Rosio Alvarez of the University of Massachusetts (USA) examines the implementation process of an ERP system and shows that implementation cannot be viewed solely in instrumental terms. The chapter presents a case study of an ERP implementation at a large non-profit. The case study demonstrates how ERP systems are often chosen not to be incorporated into existing organizational culture, but rather to reconstruct the organization's values and explores the implications of the choice of ERP systems.

Chapter 6 entitled, "[ERP Systems: Training Quality and Resultant Use Quality Perceptions](#)" by Nicole Mayer investigates the product quality of a training program developed at an Australian University implementing PeopleSoft, to develop a definition of training quality. The chapter compares use quality characteristics and user perceptions with training results. The authors conclude that high quality training leads to positive user perceptions of an ERP system.

Chapter 7 entitled, "[Assessing Enterprise Resource Planning \(ERP\) Adoption in the Philippines](#)" by Maria Divina Gracia Z. Roldan of the University of Philippines Cebu College, Antonio Zamora of De La Salle University and Frederick Amores of Third Wave Software Associates (The Philippines) describes and analyzes the factors which facilitate and restrain ERP adoption by Philippine business enterprises. The chapter also presents views and assumptions on the value of ERP in gaining a competitive advantage and provides insights on how organizational factors and culture contribute to successful ERP adoption.

Chapter 8 entitled, "[The Next Wave in ERP Implementation](#)" by Keng Siau and Yuhong Tian of the University of Nebraska-Lincoln (USA) provides a discussion of the background of ERP and discusses how ERP systems must be changed in order to meet the challenge of E-Business. The authors indicate that ERP systems will continue to maximize internal efficiency and will be able to adapt to the Internet needs of organizations.

Chapter 9 entitled, "[The Impact of Enterprise Resource Planning Systems on Organizational Effectiveness: An Artifact Evaluation](#)" by Jonas Hedman of Lund University and Andreas Borell of Tetra Pak Information Management (Sweden) presents an artifact evaluation of the functionality and perceived benefits of ERP systems based upon the Competing Values Model. The evaluation illustrates the effectiveness of ERP systems related to internal process and rational goal models and points out weaknesses in the areas related to human relationships and open systems models.

Chapter 10 entitled, "[Transnational ERP Systems: Three Case Studies in Brazilian Subsidiaries of Multinational Enterprises](#)" by Cesar Alexandre de Souza and Ronaldo Zwicker of the University of São Paulo (Brazil) identifies aspects involved in the use of ERP systems as transnational information systems. Specifically, the chapter analyzes three implementation cases of ERP systems at Brazilian subsidiaries of multinational enterprises.

Chapter 11 entitled, "[Enterprise Resource Planning and Knowledge Management Systems: An Empirical Account of Organizational Efficiency and Flexibility](#)" by Jimmy Huang of Nottingham University Business School, Sue Newell of the University of London, Robert Galliers of the London School of Economics and Political Science (United Kingdom) and Shan-Ling Pan of the National University of Singapore compares the characteristic differences and similarities between enterprise resource planning systems and knowledge management. The authors suggest that the two initiatives are complementary, but are only synergistic when the design of organizational routines and practices fits into the metaroutines imposed by ERP and KM.

Chapter 12 entitled, "[The ERP Marketplace: An Australian Update](#)" by Andrew Stein and Paul Hawking of the Victoria University of Technology (Australia) presents the preliminary results of an analysis of the Australian ERP marketplace. The study looks at the market movement and demographics of SAP, the dominant ERP vendor within the Australian marketplace. The chapter looks specifically at Australia and SAP's dominance. The authors then examine their directions for future research and questions that need to be answered in the future.

Chapter 13 entitled, "[A Framework for Assessing ERP Systems Functionality for the SMEs in Australia](#)" by Liaquat Hossain of Syracuse University (USA), Mohammad Rashid of Massey University¹ (New Zealand) and Jon Patrick of the University of Sydney (Australia) reports the results of a study aimed at identifying the strengths, weaknesses, opportunities and threats (SWOT) of ERP systems offered by the five leading vendors for small and medium enterprises (SMEs) in Australia. The authors develop a SWOT framework to study the functionality of the ERP systems offered by these vendors.

Chapter 14 entitled, "[The SAP Ecosystem: A Knowledge Perspective](#)" by Greg Timbrell and Guy Gable of Queensland University of Technology (Australia) explores the concepts of knowledge sourcing and knowledge strategy friction. The chapter then describes a preliminary attempt to instantiate these concepts through an exploratory case study of the SAP services ecosystem. The chapter is part of a larger study and seeks to explore the broader objective to test the power of a knowledge sourcing world-view and the explanatory power of such a perspective with emphasis on the ERP marketplace.

Chapter 15 entitled, "[A Study of the ERP Selection Process in New Zealand](#)" by Maha Shakir of Massey University (New Zealand) and Liaquat Hossain of Syracuse University (USA) provides an exploratory investigation of the ERP software selection process in New Zealand. The chapter gives a brief background describing the main features of ERP. The authors describe exploratory case studies on the ERP selection process and suggest that the selection of ERP guides the implementation process. The results further suggest that consultants play a large role in the selection process.

Chapter 16 entitled, "[Beyond ERP Systems as a Hype: Understanding ERP Systems as Distinct Technological, Organizational and Cognitive Phenomena](#)" by Eveline van Stijn of the University of Twente (The Netherlands) shows that ERP systems are not simply hype or buzz, but are rather technological, organizational and cognitive in nature. The authors indicate that ERP systems are distinguishable from other information systems because of their differences, but there are similarities as well. The authors discuss the future of ERP in academic research.

Chapter 17 entitled, "[Big-Bang ERP Implementation at a Global Company](#)" by Nava Pliskin and Marta Zarotski of Ben-Gurion University of the Negev (Israel) describes the case study of Dead Sea Works, an international multi-firm producer of Potash and other chemicals. The case study describes the purchase and implementation of a big-bang ERP implementation of SAP R/3 and the organizations attempt to minimize risk through strategic purchasing and a steering committee. The R/3 system was implemented on time and on budget. The case examines the keys to successful implementation.

Chapter 18 entitled, "[Selecting and Implementing an ERP System at Alimentos Peru page 247](#)" by J. Martin Santana, Jaime Serida-Nishimura, Eddie Morris-Abarca and Ricardo Diaz-Baron of ESAN (Peru) describes the implementation process of an ERP system at Alimentos Peru, one of the largest foods manufacturing companies in Peru. The case explains the criteria used to evaluate and select the system as well as problems that arose during implementation. Finally, the chapter discusses the benefits and challenges the new system provided.

From ERP systems' roles in e-business to guidance on how to select the best ERP system and ensure organizational acceptance and from a theoretical discussion on the definition and role of ERP systems to practical case studies describing each step in the process of ERP implementation, the chapters in this book provide essential information to all those concerned with effective ERP implementation. From managers wondering about the appropriate time or correct software to researchers concerned with the perception of ERP as a cognitive process, the chapters in this book represent the best practices and the most up-to-date research in ERP systems.

IRM Press

January 2002

Chapter 1: ERP + E-Business = A New Vision of Enterprise System

Betty Wang, Fui Hoon (Fiona) Nah, University of Nebraska-Lincoln, USA

INTRODUCTION

Companies have invested billions of dollars collectively in enterprise resource planning (ERP) systems with the objective of attaining an important business promise: complete enterprise integration. For companies faced with incompatible information systems and inconsistent operating practices, ERP has been a dream come true. ERP presents companies with the opportunity to standardize and automate business processes throughout the organizations, thus increasing productivity and reducing cycle time.

Although ERP systems have delivered value, it is becoming clear that the ERP model, which wraps organizational processes into one end-to-end application, may no longer be sufficient for today's fast-moving, extended enterprises. With the rapid growth of the Internet, the business environment has changed dramatically. The world has become a global marketplace. According to Gartner Group, the worldwide business-to-business (B2B) market is forecasted to grow from 145 billion in 1999 to 7.29 trillion in 2004 (King, 2000).

E-business has changed the definition of enterprise systems. Beyond the core business functions that ERP has traditionally focused on, e-business pushes the ERP from the inside core of the companies to the network edge. Companies are realizing that the most challenging part of e-business initiatives is not in developing a Web storefront but in extending ERP to accomplish business-to-business (B2B) and business-to-consumer (B2C) solutions. A new extended enterprise system emerges by integrating ERP with e-business, which creates business that is more agile, more focused and more competitive than traditionally structured business and tight B2B connections. With the help of the componentization concept, a seamless, end-to-end flow of information and process across the value chain of companies becomes realistic.

ERP AND E-BUSINESS

ERP is a structured approach to optimizing a company's internal value chain. The software, if implemented fully across an entire enterprise, connects the various components of the enterprise through a logical transmission and sharing of data (Norris et al., 2000, pp.12-13). When customers and suppliers request information that have been fully integrated throughout the value chain or when executives require integrated strategies and tactics in areas such as manufacturing, inventory, procurement and accounting, ERP systems collate the data for analysis and transform the data into useful information that companies can use to support business decision-making. ERP systems, if implemented successfully, enhance and redesign business processes to eliminate non-value-added activities and allow companies to focus on core and truly value-added activities. The following are two examples where ERP systems have dramatically increased the efficiency and productivity of companies: IBM has used ERP to reduce the processing time for updating pricing data from 80 days to five minutes and Chevron has used ERP to decrease its annual purchasing cost by 15%.

E-business stands for "electronic business," which involves communications and doing business electronically through the Internet. E-business is defined as "the use of electronically enabled communication networks that allow business enterprises to transmit and receive information" (Fellenstein and Wood, 2000). It can significantly improve business performance by strengthening the linkages in the value chain between businesses (B2B) and consumers (B2C). Besides increasing efficiency in selling, marketing and purchasing, e-business achieves effectiveness through improved customer service, reduced costs and streamlined business processes. Furthermore, e-business creates a strategic, customer-focused business environment for shared business improvements, mutual benefits and joint rewards. Companies use the Internet to implement customer-relation-management (CRM) and supply-chain-management (SCM) capabilities, which enable them to link their operations seamlessly with customers and suppliers. For example:

Nantucket Nectars, a juice manufacturer with 40% growth and \$70 million in annual sales revenue, sells its organic juices through 150 distributors nationwide as well as general stores and juice bars in Nantucket. By using Oracle's ERP system and e-business platform, the salespersons can track sales and promotions through the Internet, and are provided assistance and suggestions to enhance their performance. The salespersons and distributors have access to commission reports, and they can track and adjust sales orders. Through consolidating its financial, compensation, sales and depletion data into a single report, Nantucket prevents out-of-stock and partial shipments. The forecasted need for 50% more labor force to handle customer service issues in the past was eradicated by integrating ERP system with e-business (Oracle, 2000).

By definitions and by their respective functions, traditional ERP systems take care of internal value chain (i.e., within a company) whereas e-businesses establish the value chain across the market and the industries. More and more companies construct their systems' architectures by integrating ERP systems with e-business. They use Web-based interface (corporate portals) with outside entities plus add-on modules such as CRM, SCM, etc. in the integration.

E-BUSINESS PUSHES ERP TO THE NETWORK EDGE

In a traditional business process, after a customer order is received, the order information flows from department to department through order entry, manufacturing, warehousing, distribution and finance until the product is delivered to the customer and the payment is received. The key elements of the value chain have been controlled by separate and disparate information systems that could not communicate with one another. Not only did the companies not take an integrated view of their own business processes, but they also had an equally vague understanding of how their systems relate to the systems of their suppliers, competitors, business partners, distributors and customers. Hence, these transactions are typically carried out with minimal or no shared business processes.

In recent years, there has been a revolution in systems planning and design. Management takes an integrated company-wide view of its IT investments and choices, and implements an ERP system that integrates the core business processes of an entire company into a single software and hardware system. Customers, suppliers and business partners are consciously included in the business process, systems operation and systems development.

An ERP system is analogous to the internal technological hub of a company. When fully implemented as an integrated suite, it can be thought of as a company's central repository. The five major processes in a typical ERP system are: finance, logistics, manufacturing, human resources and sales/marketing (refer to [Figure 1](#)). The focus of ERP systems is on the efficiency and effectiveness of the internal process. It offers a way to streamline and align business processes, increase operational efficiencies and bring order out of chaos.

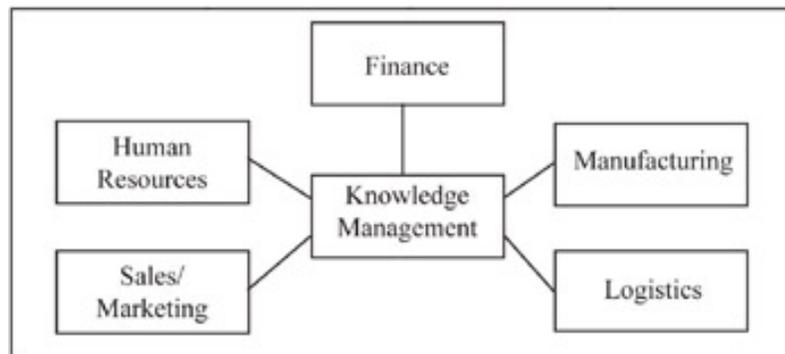


Figure 1: ERP system with five major processes

E-business is focused on efficiency and effectiveness of external, cross-enterprise processes. While ERP technology supports business strategy, e-business opens the door to new strategic opportunities, which forces ERP to take one step further; to move from the single ERP system model to the extended ERP system model (refer to [Figure 2](#)). The Web technology provides the bridge between companies and their business partners to make e-business possible, while e-business makes the ERP system more transparent and outward. Instead of thinking about ERP within a company, we may view the ERP system along the value chain of companies in the same industry, or across industries. Companies are now turning their attention outward to engage in business with customers, suppliers and business partners through the use of the Internet and Web-based technologies. ERP functionality has to move onto the Web because that is where most of the core business processes are being carried out. The earlier example on the flow of a customer order and the steps in the process flow across the boundaries of the companies would now be handled by a number of different companies behaving as if they are one.

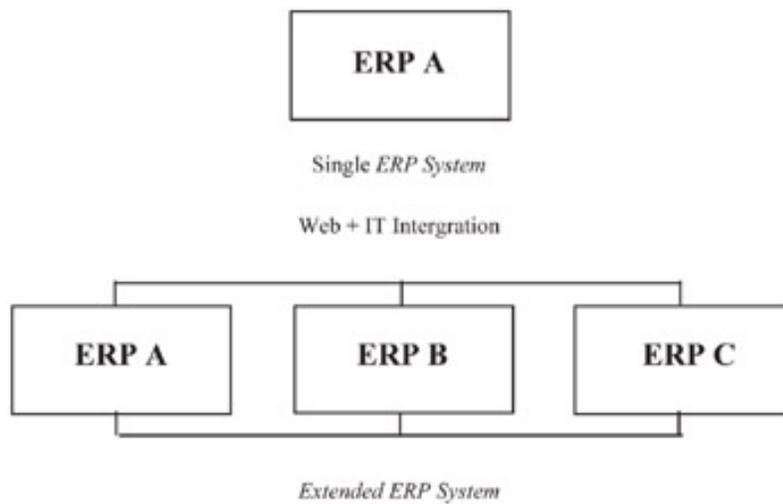


Figure 2: Single versus extended ERP system

If a corporation decentralizes autonomous business units, they need to be able to access and share data between departments, managers and employees. With ERP systems, a transaction only needs to be entered once. The system can process the transaction across different software modules, resulting in highly comprehensive and integrated information that can be used for decision-making. While an ERP system can be viewed as a repository for data, information and knowledge, and it extends beyond functional boundaries by redefining enterprise wide processes, a Web-enabled ERP system forces companies to look at processes that span multiple enterprises (refer to [Figure 3](#)).

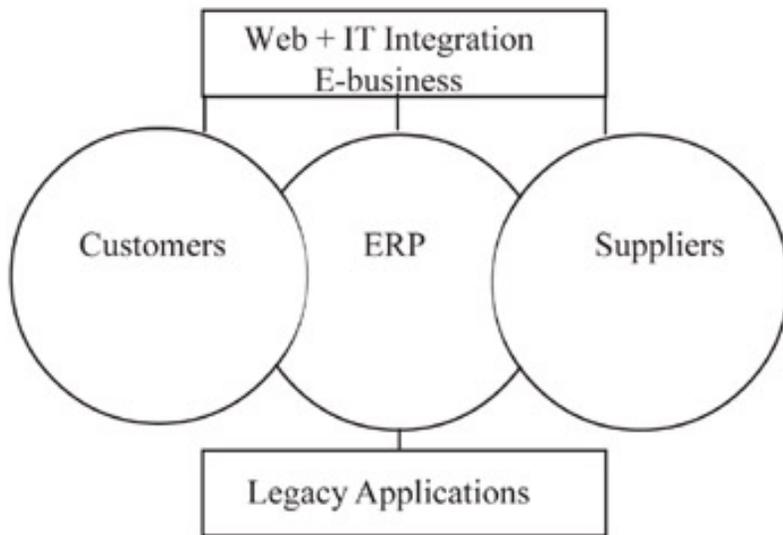


Figure 3: ERP integration with e-business

When e-business is integrated with ERP, the whole extended system provides a vision of business processes that span multiple businesses and enterprises. In the most ideal case, companies should be able to connect disparate platforms, applications and data formats across the value chain, including not only suppliers, but also customers as well. Furthermore, companies should retain the flexibility to change and add functions to applications as business needs evolve. Companies need to be able to adapt their ERP systems to the emerging world of e-business (refer to [Figure 3](#)).

ERP SOLIDIFIES THE FOUNDATION FOR E-BUSINESS

In a recent survey by *Information Week*, 66% of IT managers viewed ERP as their most important and strategic platform because it provides a solid foundation and information backbone for e-business. When ERP and e-business are properly implemented, they supercharge each other. E-business is the best vehicle to share business information with partners for creating major B2B synergies (Norris et al., 2000, p. 93). A fully integrated ERP system will capture and create accurate, consistent and timely relevant data, and assist in intelligent business decision-making. The impact of ERP/e-business integration is substantial, ranging from reduced inventory and personnel level to improved order and cash management. It also results in improved customer responsiveness, reduced IT costs and the availability of resources for value-added activities. The following case is an example where the full integration of ERP with e-business and SCM led to successful business (Sun, 1999; Whiting, 1999):

Colgate Palmolive Company, with \$9 billion in consumer products business, has five regional divisions in North America, South America, Europe, Asia/Pacific and South Africa. The implementation of SAP R/3 in 1993 helped Colgate reduce its finished inventory by 50% and cut order receipt-to-delivery time for its top 50 customers from 12e to five days.

Because of its tremendous increase in international sales and the constantly changing manufacturing/distribution model, Colgate integrated its SCM-called supply network planning with its e-business platform from Sun Microsystems to leverage its existing ERP in early 1998. This supply network planning system together with the vendor-managed inventory (VMI) software helped Colgate-Palmolive manage its inventory at customer sites (such as Kmart distribution locations). By mid-1999, Colgate implemented the Web-enabled supply network planning modules in all of its North America manufacturing and distribution facilities. The VMI software was installed at about 70% of the customer facilities, which accounts for half of the company's sales volume. In the later part of 1999, Colgate implemented the production planning, detailed scheduling and demand planning of supply network modules, and integrated them with SAP sales and service applications and business information warehouse software.

Colgate is seeing a clear payoff on improved service to customers and suppliers. Since it achieved manufacturing efficiencies from ERP/e-business, the company has been having single-digit growth on sales revenues and double-digit growth on net income every year (Colgate, 2000). Now, the company is counting on its ERP/e-business to further the operating efficiencies.

The companies that have successfully implemented ERP systems will become the masters in helping other suppliers to integrate ERP and e-business to create a Web-based extended ERP environment. A well-run Web-enabled ERP system will make the entire value chain very powerful. Examples of successful cases include Sun, IBM, Compaq, Intel and Cisco in the high-tech industry; CitiGroup, Bank of America and Charles Schwab in the financial services; and Amazon.com in the retail industry.

A NEW VISION OF ENTERPRISE = ERP + E-BUSINESS

Although ERP integrates core business functions such as logistics, finance, human resources and sales-order administration, there are still many business processes that ERP cannot address. ERP falls short of meeting today's demands from customers for better services. With Web-based technology, information can move swiftly through the value chain, making companies anxious to add functionality to implement specialized applications that can meet their needs.

Componentization

The Butler Group, a British IT consultancy group, indicates it has seen a backlash against the inadequacies of monolithic application packages and argues that techniques to integrate applications can lead to better solutions without the stranglehold of inflexible functionality (Economist, 1999, p.32). The key question is how to continue adding new functionality rapidly at low cost while making it easier for organizations to implement and upgrade to a platform appropriate for e-business. The ERP vendors and customers are relatively quick to recognize the benefits of componentization.

Before e-business was taken into consideration, most of the ERP systems that have been implemented were delivered as monolithic code and did not employ the componentization concept. Barricaded behind complex, proprietary Application Program Interfaces (APIs) and based on complex, nearly indecipherable relational database schemas, ERP systems do not readily extend to e-business. With the popularity and widespread practice of the object-oriented approach, component-based techniques become essential quality requirements.

Componentization is the action of breaking up a large, monolithic ERP system into individual modules that would work together. Components are pieces of code that can be interchanged between applications. This idea is similar to the assembly of automobiles, airplanes and mobile phones. They are combined from parts that work together within an architecture. The parts are not a homogeneous set, but comprise many different types and standards. According to Sprott (2000, p.65), a component can be any form of implementation, provided it adheres to the concepts of separation, interfacing and standardization. Most ERP vendors are converting their ERP systems to a component-based architecture. When ERP is componentized, the internal functions performed by the system are represented using object-oriented blocks of code that can be used to create new applications (Callaway, 2000, p.116). The componentization of functionalities in ERP will make the internal and external systems more adaptable and reliable. Therefore, it will smooth the information flow along the value chain.

Based on the object-oriented concept, each functionality of ERP can be viewed as a separate encapsulated entity and treated as a component. By virtue of the independence of components, it is easier to manage, upgrade and modify a component-based ERP system. Granularity, scope boundaries and internal cohesion are important attributes of a component. A fine-grained component will be simple to upgrade because it involves fewer relationships but requires more management since there is likely to be many more parts needed to meet the requirement. In contrast, a larger component may be easier to manage but would require more effort to modify and implement because the scope of the functionality is much broader and the impact of changes is much greater. Since the components encapsulate individual business processes that other components can freely access, companies can more precisely control individual business processes. This divide-and-conquer approach allows the companies to do rapid concurrent development (Erlikh, 2000, p.17). Componentization breaks large-scale business processes into self-contained units of manageable size and makes it easier to deploy ERP systems in an e-business environment.

ERP and e-business applications can be assembled from Web-based components such as Online Analytical Processing (OLAP) components, batch components, application components and database components. A company implementing an ERP system would be able to select different modules or components from multiple vendors instead of picking a single vendor. Since an ERP system can be broken down into components by functionalities, the vendors would be able to quickly fix or add functionality to ERP systems. An individual component of ERP can be enhanced without affecting any other functional components. IBM research shows that only 20% of companies use a single ERP vendor. Almost 80% of companies use multiple vendors (IBM, 1999).

Using the Internet-enabled ERP as a foundation, componentization delivers one or more services. The service is the function that the component provides to the user (another server or client). As indicated by Sprott (2000, p.65),

A service might therefore be something very simple such as a LOOK UP SYNONYMS service provided by a Thesaurus component, or as comprehensive as UPDATE NEW

CUSTOMER INFORMATION service provided by a Customer Relationship Management (CRM) application. A series of services provided by multiple disparate components might be integrated into a common workflow that performs a unified business purpose.

It is very important that the interface and service provided are independent of the underlying implementation. For example, an implementation of ERP may be provided by a legacy database. With componentization, the legacy database can be replaced by an object-oriented database with no effect on the user of the service, provided the interface remains unchanged.

Flexible Customization

ERP vendors will come under considerably increasing pressure as they are forced to open up their products and to market components separately before the ERP market becomes saturated. It is becoming increasingly popular for components to be assembled by customers since companies need flexible ERP systems where new applications can be added fairly quickly and business intelligence can be extracted to fit into B2B and B2C solutions. The successful ERP vendors are beginning to provide customers with flexible and economical operational infrastructure that easily integrate with open market components. These vendors allow customers to exercise considerable choice in procurement to create customized solutions from readily and widely available building blocks.

A major advantage of component-based ERP is the incremental release and upgrade process. This is a benefit in the initial implementation as well as ongoing enhancement. Many ERP vendors and existing customers underwent considerable upgrade pain before they could achieve this result. The realities of upgrading are also not as simple as one might think. A complete integration test should be undertaken because of the high levels of interdependence between the components. The ultimate goal is to develop ERP components that are compatible with one another and that can be easily integrated with e-business and other applications.

COMMON ERP/E-BUSINESS PLATFORM (ORACLE & SAP)

Today, customers expect more than ever before. To meet these expectations, companies need to reach out and bring customers closer to their information systems and have them engage in product configuration, selection and Internet self-service (*Economist*, 1999, p.32). Also, it is essential for the vendors to set up a compatible e-business platform for system integration. Some major ERP vendors launched their Web-enabled ERP in the early part of the year 2000 to create the B2B and B2C solutions. Both Oracle and SAP set up Internet portal (hub) and use eXtensible Markup Language (XML) to manipulate data from internal ERP and push information flow across the value chain (refer to Figure 4).

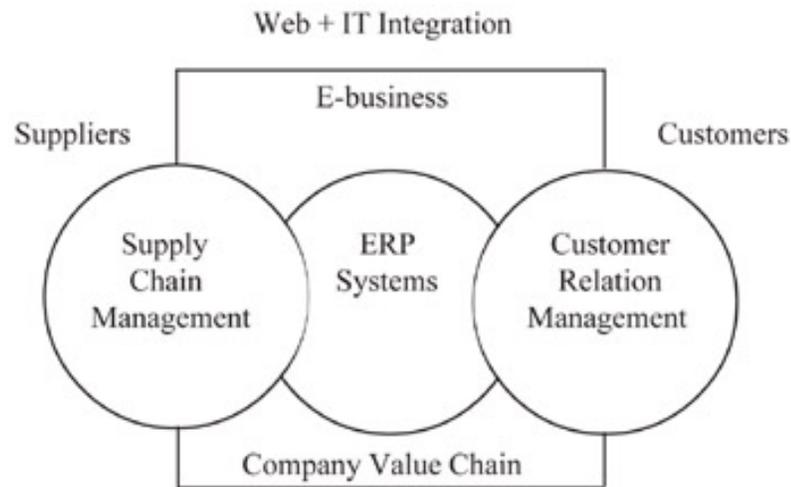


Figure 4: Extending ERP along the value chain

The portal (hub) technology could provide the necessary access, while adding a variety of new features and capabilities for the users. XML is a meta-language for describing data so it can be interpreted in a more intelligent way. XML is designed to provide structured to semi-structured or unstructured data, the kinds of data that abound on Internet and e-business settings (PriceWaterhouseCoopers, 1999). XML uses a native Web approach that enables extensible data-exchange formats and provides the flexibility to create one's own data tags to develop a shared Internet file system (Fingar et al., 2000, p.253). XML revolutionizes the Web since it allows structured data³with standard names and consistent semantics⁴to be moved around the Web in a simple and straightforward way, as easily as HTML does today.

Oracle (Oracle, 2000)

Oracle, the number one player in ERP, and the dominant supplier of relational database to the Windows NT and Unix market, became a leading independent software company worldwide. Oracle's Internet Platform provides a comprehensive solution for ERP integration. Based on the popular hub-spoke-adapter architecture, Oracle uses XML to extract information from legacy and ERP applications. The information will be renderable through "Portlets" on the desired site (refer to Figure 5).

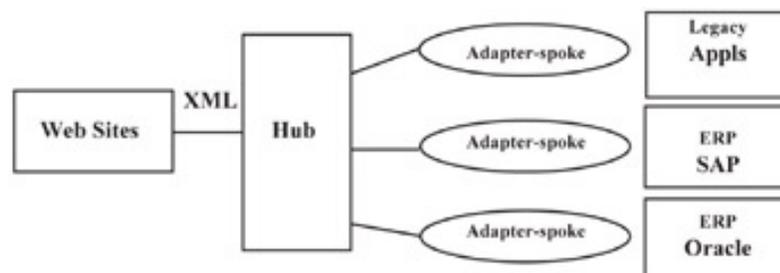


Figure 5: Oracle's hub-spoke-adapter architecture for ERP/e-business

Its e-business (WebDB) platforms have the following functions:

- *Reduce complexity from interlinked applications and packages*

The change in business requirements over the years has inextricably linked applications in a confusing tangle of connections across departments and business segments. However, no company can scrap its entire IT infrastructure and begin jam scratch again. Therefore, the portal platform has been used to provide better employee access to tools, applications and data.

- *Legacy heterogeneous environments*

Legacy applications need to coexist with best-of-breed supply-chain, knowledge management and customer-relation applications on the Internet. It serves as a consistent mechanism for inter-application communication that facilitates cooperation among heterogeneous legacy applications.

- *Global operations*

E-business breaks the boundaries of regions and countries. All operations are globalized. The portal platform is a better way for the companies to link applications and business processes to achieve their e-business goals.

SAP (SAP, 2000)

Established in Germany in 1972, SAP possesses 33% market share worldwide. With more than 20,000 employees and an increase in revenue of 60% per year, SAP is another major ERP provider in the world. SAP uses the front-office market with a number of new Web-based applications covering B2B procurement, B2C selling and B2B selling—all designed to integrate with its market-leading R/3 suite. SAP believes this will be the key to extending its franchise into e-business.

R/3 is a client/server architecture product that uses the "best" enterprise business practices and supports immediate response to change throughout the organization on a global scale. R/3 currently contains modules for more than 1,000 business processes that may be selected from the SAP library and included within installed SAP applications, tailoring the application solution to the customer.

In early 2000, SAP uses an open Internet hub that provides both services and integration for companies to collaborate across business processes, conduct commerce, access personalized content and interact in professional communities (refer to Figure 6).

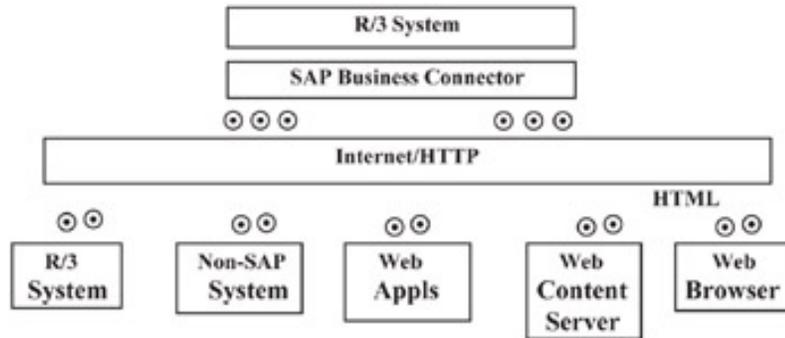


Figure 6: SAP's platform for ERP/e-business

Its e-business platform consists of the following functions:

- *End-to-end Web business processes*

The XML has been used to allow the exchange of structured business documents over the Internet to provide a common standard for different applications and IT systems to communicate and exchange business data. XML provides the bridge between different systems, companies and users. It provides an easy way to put flexible end-to-end business processes in place.

- *Open business document exchange over the Internet*

The SAP Business Connector is based on open Internet communication standards. It uses the widely available hypertext transfer protocol (HTTP) to exchange XML-based business documents over the Internet. XML defines common business semantics to business documents such as

orders, invoices, etc. With XML, the lingua franca of the Internet, business documents exchange across applications and systems are easily available.

- *XML-enabled SAP solution*

The SAP Business Connector makes all SAP solutions accessible via XML-based business documents. It supports all major existing interfaces provided by SAP and empowers SAP customers to instantly benefit from SAP functionality over the Internet. This makes SAP solutions an integral part of their e-business solution. With the availability of Business Applications Programming Interfaces (BAPIs), customers can jump-start into the Internet age with their individual solutions by using R/3 with more than 1,000 BAPIs. The SAP's Application Link Enabling (ALE) capabilities are supported. Fully cooperative business solutions now require only a widely available and cost-effective Internet connection.

- *Flexible adoption of evolving business document standards*

SAP Business Connector provides an easy-to-use graphical tool to convert and provide mapping between the SAP business documents and the XML-based business documents that are needed to collaborate with any business partners.

- *Web automation*

The SAP Business Connector makes it easy to leverage the information and processes available at a company's Web site. For example, companies can use the SAP Business Connector to retrieve catalog information from a supplier's Web site and integrate the information with internal applications automatically and in real time.

CURRENT ISSUES

With the rise of e-business, integration becomes a challenging but mission-critical task in the corporate use of information technology. Some companies are reluctant to implement ERP/e-business due to the greater complexity involved in integration. The integration of ERP with other Web-enabled applications (CRM, SCM) is a complicated and timing-consuming process. The cost of software, implementation, training and maintenance will increase. The key e-business issue in application integration is to link e-businesses to other applications (that may be based on different technologies, business models and data models) without breaking the value chain (PriceWaterhouseCoopers, 1999, p.130). Enterprise Application Integration (EAI) software helps to integrate applications by packaging together the commonly used functionalities; combining popular enterprise packages and legacy applications in a predefined way. Therefore, EAI will make ERP/e-business integration and componentization simpler and more practical. In addition to the above issues, other issues remain in implementing ERP, integrating the systems and outsourcing ERP/e-business.

ERP implementations provide the backbone necessary for e-business. Without successful implementations of ERP, the capabilities provided by Web-based functions are limited. The growing number of horror stories about failure or out-of-control projects should certainly be brought to the companies' attention: FoxMeyer Drug argued that its ERP system drove it to bankruptcy before connecting its system to the Net. Mobile Europe spent hundreds of million of dollars on ERP only to abandon it when its merger partner objected. Dell Computer found that its system would not fit its new and decentralized management model (Buckhout et al., 1999, p.16).

Despite the promise and the high investment needed in implementing ERP systems and in linking ERP systems to the e-business infrastructure, statistics show that more than 70% of ERP implementations, whether self-created or designed by established ERP software vendors, fail to achieve corporate goals (Davenport, 1998, pp.122-123). The main reasons for ERP implementation failures are due to business and management problems. Companies fail to reconcile the technological imperatives of the ERP with the business requirements of the enterprise itself (Davenport, 1998, pp.122-123). If a company rushes to install an ERP without first having a clear understanding of the business implications within an Internet economy, the dream of integration can quickly turn into a nightmare. The logic of the ERP may conflict with the logic of the e-business.

Many companies implemented ERP due to its ability to bring order and efficiency through internal standardized business processes. However, every company has its unique business requirements and needs. Standardized processes that fit every organization are very difficult to develop. By implementing ERP, some companies have replaced proprietary processes that were better suited for their needs with standardized ERP processes. Since ERP business processes are often rigid and the components of the ERP from different vendors are usually not compatible, companies have found adapting ERP to new market demands to be difficult. In SAP R/3, most of the customers inevitably find that at least 20% of their needed functionality is missing from the package (Scott and Kaindl, 2000, pp.111-112). Componentization of ERP functions is in dire need.

According to Tse (*Economist*, 1999, p.32), a senior analyst at the Yankee Group, companies need to understand that e-business requires something close to building a second backbone system on top of ERP. They should also realize that it would be neither quick nor easy. IBM estimated that 70% of all codes written today consist of interfaces, protocols and other procedures to establish linkages among various systems (*Economist*, 1999, p.32). A software analyst at BancBoston, Robertson Stephens, said he spent 50% of his time on enterprise application integrations. The integration requires companies to provide more IT and end-user training. There is a longer learning period requirement for the daily operation. The sheer size, scope and complexity of these projects usually exceed expectations. The result is that companies often wait for years before they begin to see benefits. Lack of functionalities in ERP is forcing business processes to fit the software, and bolting on customized programs, while adding to the time and cost of implementation. Moreover, some alternatives, such as using work-around and customizing the software, increase the difficulty of upgrading to new releases of the ERP package (Scott et al., 2000, pp.111-112). More often than not, projects wind up late or over budget. In the meantime, business time horizons have grown ever shorter. By the time companies have installed their ERP systems, their business has moved on and their original requirements have changed.

Outsourcing implies the use of external agents to perform an organizational activity. Companies consider outsourcing when: 1) cost saving is expected; 2) management wants to focus on its core business; and/or 3) the internal information systems function is perceived to be inefficient, ineffective or technically incompetent. Based on case studies, Lacity and Hirschheim (2000, p.324) suggest that outsourcing decisions may be a result of rational consideration and/or it may be a product of organizational politics, conflicts and compromises. Many companies are outsourcing their ERP/e-business implementation and integration to the best-of-breed vendors to simplify the daily operation and to better control the budget. This enables organizations to focus on their core businesses. Besides, many outsourcers price their services on a monthly basis with a fixed fee. This allows companies to

better manage the cash flow and eliminate the large outlays typically associated with software rollouts and upgrades.

However, there are challenges in outsourcing ERP/e-business, most of which are strategic and technological issues:

- Renting remotely hosted ERP with e-business functionalities will have impact on the way independent software vendors conduct business. Therefore, it is essential that the vendors provide enough bandwidth and a high level of reliability to ensure that the applications perform at a necessary level for consistent and acceptable service and 24-7 availability.
- Success in ERP calls for extensive customization for power users. (In reality, ERP in midsize and small companies normally does not need much customization.)
- Companies should consider the possible leak of their business logic when outsourcing ERP. Manufacturers that outsource their ERP processes to a third party are launching themselves on a slippery slope to oblivion. For instance, when General Motors outsourced its ERP, it took them years to rebuild that infrastructure. A study of 40 US and European companies concluded that outsourcing led to problems and disappointments (King and Malhotra, 2000, pp.324).
- Outsourcing ERP/e-business may actually result in higher cost. According to *InformationWeek*, 19% of respondents said they didn't outsource ERP because they didn't believe it would be a cost-effective solution (Maeyaschuk, 2000).
- ERP/e-business outsourcing solution is only dominant in midsize and small companies. According to Mega Group, 60% of small and midsize companies are interested in outsourcing ERP (Grzanka, 2000). The large corporations are less likely to outsource their backbone systems.

FUTURE TRENDS

The rapid growth of the Internet will lead to a large increase in the number of ERP users. Companies are eliminating disintegrated legacy systems by replacing them with Web-enabled, integrated ERP systems. These integrated systems become part of the overall business strategy that connects an enterprise with its suppliers and customers, and transforms the entire value chain. Companies that intend to move into a net economy are beginning to emerge and focus on multi-enterprise systems integration and growth. They are forming strategic partnerships with major e-business infrastructure providers (Sun, IBM and Microsoft) to continuously integrate their ERP systems for reaching the internal and external performance target. Major ERP vendors (Oracle, SAP, BAAN, JD Edwards and i2) are constantly updating and releasing integrated ERP/e-business suites to support an open, collaborative and competitive business environment:

- The major ERP vendors will continue to build compatible and adaptable ERP components and develop extended ERP solutions designed to address the latest market demands. For example, Oracle's Release 11i is a business application suite that consists of Supply Chain Management, Order Management and new self-service software modules. It is tied to a Customer Relationship Management (CRM Release 11i and Oracle Exchange) application (Wilson, 1999, p.2). The whole software suite works seamlessly with one another to handle everything from customer service on one end to relationship with suppliers on the other. It is all rejiggered to run on the Web. Based on the company's vision, anyone from giant corporations to tiny dot-coms can buy a single package from Oracle to run their e-business, rather than buying software from a host of competitors and trying to stitch it all together (Outsourcing-erp.com, 2000). If it works, it will move computing from desktop PCs to huge Internet servers that run anything from Web sites to complex corporate networks. Oracle's skills and technologies are taking the center stage. JD Edwards offers its OneWorld Software as a host service over networks. This application service is designed to be easier to deploy and adapt (Wilson, 2000, p.13). It will overcome the inflexibility of the ERP system on its implementation time.
- With the convergence of the Internet and wireless technology, users can access Web-enabled ERP systems anytime and anywhere through the use of newer and easier-to-use devices, such as personal digital assistants, smart phones, in-devices and biometric tools. For example, an accounting manager who is out of town will leverage his company's ERP with a personal digital assistant to review financial reports and give directions to his subordinates. He/she can log on to the system using his/ her fingerprint or voice.
- The use of XML in B2B communications will enable a host of new relationships between companies, vendors, suppliers and customers. Exporting data from application suites and developer tools using XML will become a standardized feature. For example, IBM translates generic XML information into device-specific formats that can be used on wireless devices.
- Outsourcers, ERP vendors and e-business infrastructure providers alliance together to provide more robust, scalable and compatible e-business platforms for the companies. PriceWaterhouseCoopers has built a strategic relationship with the Sun-Netscape Alliance (an alliance of Sun and AOL) to provide technology and services that enable companies to build business-critical e-business solutions that leverage investments in SAP R/3. Netscape Application Server for R/3 has provided a reliable infrastructure for Web solution (iPlanet) that allows customers to access PriceWaterhouseCoopers' SAP system in a secure manner (iPlanet, 2000).
- The future trend of ERP outsourcing is to explore into the applications service market. By the year 2003, offering ERP service over the Web will be a \$2 billion business, as more than a dozen Application Service Providers (ASPs) are moving into the market (Gartner Group, 2000). ASPs take ERP and non-ERP applications from multiple vendors and put them together into a service. Rather than selling their creations inhouse to corporate customers, they make their products available over the Web on a lease or rental basis. In addition, some mid-market companies are seeking to outsource their non-core business processes, such as payroll and employee benefit administration. According to a recent survey, 75 to 80% of a company's financial cost is tied up in labor or labor support. As stated by Marion (1999), any realistic attempt to reduce or manage costs in the finance and administration area has to focus not only on improved technology, but also on labor issues; the high costs of labor and the shortage of skilled labor.

CONCLUSION

If you're not doing business on the Web, you'll miss the boat. It's the wave of the future (Hamm, 2000, p.117). Given today's information age, e-business is the solution to dictate a successful information economy. However, companies can do little to move into this stage without the underlying (ERP) infrastructure in place as a foundation (Menezes, 2000, p.2). Today, extended ERP systems with front-end e-business connect an organization's "front office" (customer facing) and "back office" (business processes) operations to meet its global emerging market. Extending ERP means unleashing critical information and making it accessible to employees, customers and business partners, so that the various entities along the entire value chain can make better decisions.

Indeed, best practices consist of real-time, cross-enterprise, Internet-based flow of information, documents and processes, that is routed and driven in the most efficient and effective way. From a technical point of view, development and deployment of e-business models never stop. Companies should constantly reinvent to leverage changes in e-business technology and its ERP integration, or other business applications. New e-business models are emerging as companies in all industries are transforming themselves to compete in the Internet economy. Successful transformation requires new e-business strategies and processes, as well as robust and scalable application and technology platforms. With the right strategy and solid execution, an enterprise can transform itself to compete and grow in today's rapidly changing business environment.

REFERENCES

- Buckhout, S., Frey, E. and Nemec, J., Jr. (1999). *Making ERP succeed: Turning fear into promise*. *IEEE Engineering Management Review*, Fall, 116°C123.
- Callaway, E. (2000). *Enterprise Resource Planning: Integrating Application and Business Processes Across the Enterprise*. Computer Technology Research Corporation.
- Colgate Press Room. Retrieved August 23, 2000. (Masterfile) on World Wide Web: <http://www.colgate.com/press/earn/>.
- Davenport, T. (1998). *Putting the enterprise into the enterprise system*. *Harvard Business Review*, August, 121°C131.
- Economist. (1999). *ERP RIP? The Economist*, June, 29°C34.
- Erlikh, L. (2000). *Leveraging legacy system Dollars for e-business*. *IT Professional*, May/June, 17°C23.
- Fellenstein, C., and Wood, R. (2000). *Exploring E-Commerce, Global E-Business, and E-Societies*. Prentice Hall.
- Fingar, P., Kumar, H. and Tarun, S. (2000). *Enterprise E-Commerce: The Software Component Breakthrough for Business-to-Business Commerce*. Meghan-Kiffer Press.
- GartnerGroup. (2000). *New and Upcoming Research*. Retrieved February, 2000. (Masterfile) on world wide Web: <http://www.erphub.com/>.
- Grzanka, L. (2000). *ASPs and the renter's dilemma*. *Knowledge Management*, May, 44°C48.
- Hamm, S. (2000). *Oracle: Why it's cool again?* *Business Week*, May 8, 114°C126.
- IBM. (1999). *Beyond ERP: Achieving Greater Return on ERP Investments*. Retrieved February 2000. (Masterfile) on World Wide Web: <http://www.ibm.com/erp/n1>.
- iPlanet. (2000). *Sun-Netscape Alliance's Vision for Net Economy Integration Amasses Global Support from Industry Leaders, Customers*. Retrieved August 22, 2000. (Masterfile) on World Wide Web: http://www.iplanet.com/alliance/press_room/press_releases/integration2.html.
- King, J. (2000). *How to do B2B?* *Computerworld*. Retrieved February 23, 2000. (Masterfile) on World Wide Web: <http://www.computerworld.com/>.
- King, W. R., and Malhotra, Y. (2000). *Developing a framework for analyzing IS sourcing*. *Information & Management*, (37), 324°C333.
- Lacity, M. C., and Hirschheim, R. (1993). *Information Systems Outsourcing: Myths, Metaphors and Realities*. John Wiley & Sons.
- Maeyaschuk, J. (2000). *ASPs Offer Benefits Through Economies of Scales*. Retrieved April 2000. (Masterfile) on World Wide Web: <http://www.techweb.com/>.
- Marion, L. (1999). *D'jà vu All Over Again: The Return of Time Sharing*. Retrieved February 2000. (Masterfile) on the World Wide Web: http://www.erphub.com/strategy_9907erp1.html.
- Menezes, J. (2000). *Shrinking Profits, Markets, Impact ERP*, *Computing Canada*, January, 2°C3.

Norris, G., Hurley, J. R., Hartley, K. M., Dunleavy, J. R., and Balls, J. D. (2000). *E-Business and ERP-Transforming the Enterprise*. PriceWaterhouseCoopers.

Oracle. (2000). *E-Business Integration*. Retrieved January 2000. (Masterfile) on World Wide Web: <http://www.oracle.com/ebusiness/integration>.

Outsourcing-erp.com. (2000). *Big ERP Solutions for Mid-Market Companies*. Retrieved April 2, 2000. (Masterfile) on World Wide Web: <http://www.outsourcing-erp.com/html/corpcare.html>.

PriceWaterhouseCoopers. (1999) *E-Business Technology Forecast*.
PriceWaterhouseCoopers.

SAP. (2000) *mySAP.com Marketplace*. Retrieved February 2000. (Masterfile) on World Wide Web: <http://www.sap.com/marketplace>.

Scott, J. E., and Kaindl, L. (2000). *Enhancing functionality in an enterprise software package*. *Information & Management*, (37), 111-122.

Sprott, D. (2000). *Componentizing the enterprise application packages*. *Communications of the ACM*, (4), 63-69.

Sun. (1999). *Colgate Palmolive Company¹ Sun Provides Global Network Computing Solution*. Retrieved August 22, 2000. (Masterfile) on World Wide Web: <http://www.sun.com/>.

Whiting, R. (1999). *Colgate goes live with SAP supply chain² company seeks to build on R/3 gains*, *InformationWeek*, April 26. Retrieved August 2000. (Masterfile) on World Wide Web: <http://www.techweb.com/se/directlink.cgi?IWK19990426S0029>.

Wilson, T. (1999). *Oracle suite integrates ERP, e-business apps*, *InternetWeek*, October, 2-3.

Wilson, T. (2000). *Handing off the burden*, *InternetWeek*, January, 13. (Masterfile) on World Wide Web: <http://www.e-business.pwcglobal.com/pdf/EbusinessandERP.pdf>.

Chapter 2: e-ERP;^aA Comprehensive Approach to e-Business

Colin G. Ash, Janice M. Burn, Edith Cowan University,
Australia

The chapter reports on the results of research carried out over the last two years on the state of e-business developments within ERP environments worldwide. Structured interviews were used to collect data in two stages. The first group of organisations was drawn from Australia and the results from this stage used to refine the data collection instrument. The second group consisted of relatively mature ERP based organisations from a range of industries around the world. The findings were analysed according to an established research framework from Business Process Change. This showed that while facilitators in aspects of e-business change management such as cultural readiness, knowledge and learning capabilities and relationship building were recognised by organisations, the extent to which they were incorporated as part of the implementation varied greatly. This suggests a rich field for future research study regarding the success of e-ERP projects.

INTRODUCTION

Numerous researchers have written about e-business and the impact this is likely to have on traditional modes of business operation. According to interviews conducted by Forrester Research with 40 senior IT and e-commerce executives, Electronic business will explode by 2002 because they expect 78% of their customers and 65% of their trading partners to have global electronic connections with them, up from 40% and 43% respectively. Online revenue growth has quadrupled each year. In 1998, it totalled \$35 billion inter-company and \$15 billion retail, worldwide. In 2000, out of 256 million users, 53 million buyers will average \$4,090 each in e-commerce business (combined inter-company and retail). By 2003, online revenues will exceed \$1.3 trillion (Hesterbrink, 1999: p3).

As more and more established organisations realise the need to form alliances with their customers, partners and suppliers over the Internet, integration with ERP systems becomes a critical issue. This combination of technologies offers **established** companies the opportunity to build interactive relationships with its partners and suppliers, improve efficiency and extend its reach, all at a very low cost. For example, GE estimates to save \$500 million to \$700 million of its purchasing costs over three years and cut purchasing cycles by as much as 50% (Hesterbrink, 1999: p3). Eventually, the company expects to buy the majority of its purchases through its Web-based bidding system.

Although these technologies have distinctly different functions, integrated they offer a sound infrastructure for doing business on-line (Venkatraman and Henderson, 1998). Here e-business means "making the key business processes of an organisation available over the Internet" (Boey, 1999: p1). Although simple, this definition nevertheless incorporates some subtle but key points about e-business applications with an ERP system (e-ERP). The primary beneficiaries of this e-business infrastructure are customers, business partners and suppliers, and employees. [Figure 1](#) illustrates how these concepts relate to the core business-to-business (B2B) models, (adapted from Ash and Rossouw, 1999).

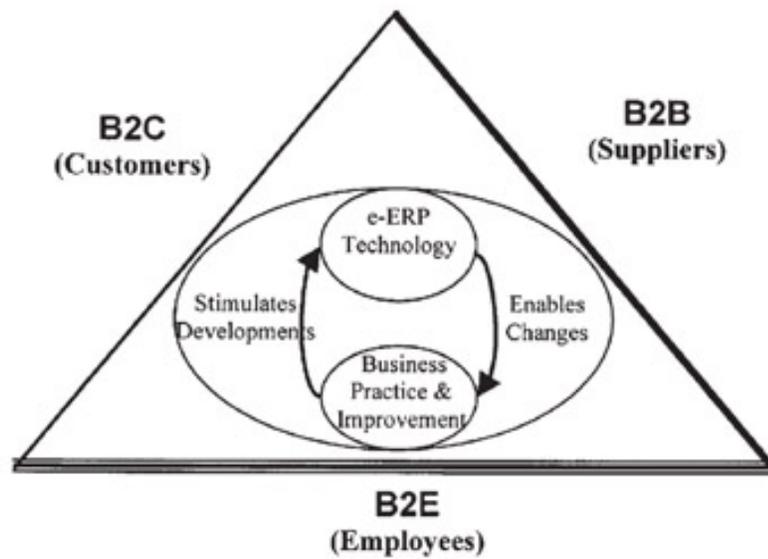


Figure 1: Developments in e-ERP and Business Practice for doing e-Business

The chapter reports on the findings from a multiple case study investigation of ERP enabled organisations that pioneered e-business projects. The key findings from each case study are captured into a theoretical framework taken from *business process change* research to derive an e-business change model. The model is then validated for future study of the broad and new complex phenomenon of e-ERP implementations.

E-ERP IMPLEMENTATIONS

To achieve the maximum level of benefits from integrating an e-business application with an ERP package, it is important to understand from the outset the complementary nature of an e-ERP implementation. The stakeholders of an ERP system are potentially every employee in the company as well as key suppliers and customers. Typically, an ERP system in its final rollout will replace the majority of legacy systems and interface with the remaining systems. To the outside world however, the ERP system will be largely transparent, as it communicates with suppliers and vendors using traditional media or standard EDI transactions.

The main focus of the implementation will therefore be the integration of cross-company value chains using e-business tools. The importance of combining ERP packages with the Internet has a two-way benefit and return on investment. "Once Internet technology is efficiently integrated into the internal operation, its effective use for external interactions becomes a natural and easy *extension*. Without the internal infrastructure, external interactions will always be strained and limited" (Telleen, 1996: p.3). The coupling of these technologies is seen as "a shift from the traditional emphasis on transaction processing, integrated logistics and workflows to systems that support competencies for communications building, people networks, and on-the-job learning" (Manville, 1997: p.11).

Investigations of Local SAP Sites

In early 1999, ten Western Australian SAP-based organisations were contacted with a view to gathering information about the state of e-business developments within SAP R/3 environments. Significantly, SAP's R/3 system dominates the local ERP landscape. A structured interview approach using open-ended questions was used to capture information of current and future use of R/3 with Internet technology. In constructing an appropriate interview questionnaire, the issue of benefit maximisation was paramount and the focus of this was towards supply chain automation based around business-to-business models (Figure 1).

In general, the responses from IT managers interviewed revealed views and expectations of future developments similar to the key findings of the Nolan and Norton Institute Australian industry based study, (NNI Report 1998):

- Integration across the entire organisation is the key to large efficiency gains;
- Transparency of implementation and change process is important, both in terms of acceptance of the change and achieving the expected efficiency gains;
- Distinguish between striving to win new markets or customers and gaining cost efficiencies;
- Develop a benefits register and measure achievements against it.

The information gathered from the 1st interviews gave rise to a generic IT strategy graph (Figure 2). The graph reflects the perceived benefits of a two-stage plan, where an R/3 implementation is followed by a second wave of Internet extensions. This evolutionary approach is observed to be the norm in Australia, for the "follower" type organisation (NNI Report, 1998). The findings below refer to the question; "What are the uses, benefits, barriers, and business drivers arising from the use of Internet technology integrated with a SAP R/3 system?":

- Generally, the term used for the vertical axis "Benefits" was seen to include "cost savings" and "efficiencies" with internal processes.
- Most respondents agreed that Internet integration would lift the "Benefits curve", ie increase benefits, but the increase would not be exponential as shown by the dotted curve.
- The term "bolt-on technology" was used in regard to the Internet-SAP strategy. Again, this view undermines the notion that benefits could increase exponentially.
- Most respondents perceive that business integration with the web would raise efficiency.

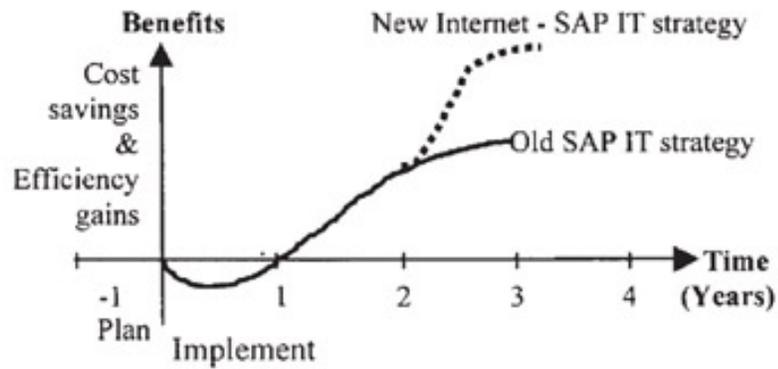


Figure 2: Benefits from Internet extended SAP R/3 Implementation

These preliminary findings match those of the NNI Report (1998), where the actual benefits achieved from adopting e-commerce technologies have proved very disappointing. "The largest gaps between expected and actual benefits are related to supply chain, product development and customer service". It is in these areas of business practice where ERP systems are regarded as being traditionally strong.

Major Investigations of Overseas SAP Sites

Late in 1999, a further ten international SAP-based organisations were contacted with a view to gathering information about their use of SAP R/3, and in particular developments in Internet integration with their R/3 implementation. To identify the sites, a search using secondary literature, web sites, and SAP related industry consultants were conducted to identify major e-ERP projects. Tables 1a, b, c summarise the profiles of the organisations that participated in the study. The "e-business initiatives" selection criteria insisted each e-business project was to have significant organisational implications.

Table 1a: Case Studies on B2B projects

Alias	Size	Country	e-Bus	Project Title	Users
http://biotech.com/	Medium	UK	B2B	Staff research procurement	200
http://o&gas.com/	Large	Norway	B2B	Staff travel procurement	10,000 +
http://pharma.com/	Global	Switzerland	B2B	Sales Order Rapid Delivery	3,000 +
Key: Small < 100, Medium < 1000, Large (national), Global (multi-national)					

Table 1b: Case Study of B2E projects

Alias	Size	Country	e-Bus	Project Title	Users
http://bank.com/	Large	Switzerland	B2B	Employee Info. Internet	1,000 +
http://employment.com/	Large	Australia	B2E (B2B)	Employee self service +proc.	1,400 +
http://engineer.com/	Global	Narway	B2E	HR Employee Tracking	100 .
http://media.com/	Global	Germany	B2E (B2B)	Simple Ordering e-catalogue	1, 000 +
Key: Small < 100, Medium < 1000, Large(national), Global (multi-national)					

Table 1c: Case Studies on B2C projects

Alias	Size	Country	e-Bus	Project Title	Users
http://charity.org/	Small	Australia	B2C	Bus Admin via appln-hosting	unlimited
http://scitec.com/	Global	UK	B2C/B	Order Request System	unlimited
http://society.com/	Small	Australia	B2C	Online Store Sales	7,500 + members
Key: Small < 100, Medium < 1000, Large(national), Global (multi-national)					

FINDINGS

The IT managers were interviewed to obtain a basic insight into each organisation's status of the use of Internet technology (web, intranets, extranets, and e-mail). They were questioned about "the benefits and barriers arising from extending their R/3 business processes onto the Internet". The findings are presented in the categories of the three basic business-to-business models (Figure 1):

- Business-to-Business (B2B) via Internet to support partners and suppliers
- Business-to-Employee (B2E) via intranets to support information/knowledge sharing.
- Business-to-Customer (B2C) via Web site to support customer interaction.

B2B e-Procurement Shorter lead times and lower costs

With SAP B2B Procurement e-business solution, Biotech reported that "lead times to fill an order were shaved down from four to just one day" from the point in time when an employee identifies an order, to actual delivery". Having achieved shorter lead times, Biotech no longer needs to keep large stocks of materials, so expenditures are down and cash flow is healthier. Indeed, the company expects to save between ten and 15 percent on the cost of purchasing materials. Another goal of the business-to-business project was to build more long-term links with preferred vendors. So far, Biotech has identified three such vendors. Their Internet sites will be linked into the SAP procurement system, allowing Biotech staff to use e-procurement on the company's own intranet and to purchase from both the internal catalogue and external online catalogues. This was made possible by a specially developed open catalogue interface. The procurement department already attributes one major success to its new procurement process: It has been able to increase the discounts previously offered by its three preferred vendors by a further five percent. But the benefits are by no means all one-sided. SAP B2B Procurement gives vendors plenty of opportunities, too, such as direct ordering. All three companies believe future benefits will come from industry portals, eg Chemicals, Oil & Gas marketplaces as follow:

- **To maximise the benefits** the notion of fast e-business adoption was emphasised. "Roll-out of the e-business solutions needs to be achieved very quickly for ROI". Also, there needs to be "full cooperation between industry partners". Collaboration between suppliers, to standardise item numbers in catalogues. Further, "it is only with content that you gain a win-win, eg industry catalogues. This implies the importance of the B2B value chain. Finally, to make use of SAP's industry portal (via <http://mysap.com/>) requires "organisational culture change".
- **To minimise the barriers** (eg resistance to change) all suggestions were concerned with technical or more practical issues. This may have been provoked by an IT driven project mindset. The procurement applications need to be much more user friendly. They recommended "an upgrade to R/3 release 4.6" and "an increase in business application program interfaces (BAPI)s".
- **In the future**, all three organisations believe their ERP technology will play an integral part in helping these established enterprises build and operate online business-to-business models. Eventually their current B2B procurement will lead to industry specific e-marketplaces.

B2E Employee Self Service Improve quality of work life

Three large established organisations in different industries implemented organisational intranets that combined with their SAP R/3 business processes. These solutions were easy to deploy while offering significant benefits from networked employees. <http://bank.com/> implemented the SAP Internet solution for internal address management. It covers all organisational information within the bank and is the most-used Web application, available for all 45,000 employees, with 300,000 transaction calls per day. It also implemented its own Intranet integrated with R/3 to facilitate the networking of the staff in the merger of two large banks. Banking is the main driver. "This is a generic back-office solution, not a SAP banking solution, to save time and paper for the distribution of staff information." It offers transparent access to important policy, manuals and procedure documents across all departments. "It also offers collective use of many functions" (Perez et al., 1999: p.49).

A major recruitment and employee services company, <http://employment.com/>, implemented SAP's Internet suite of employee self-service applications. This was used to network more than 1,400 employees in more than 200 offices, nation wide. It included an employee purchasing solution, "expected to realise considerable cost savings in our purchasing and human resources organisations over the next several years." It helped reduce administration tasks and paper (eg filling in forms, distribution of management information).

A leader in media sales and services world wide, <http://media.com/> implemented SAP Internet solutions to enable it "to further leverage its investment in its SAP system by extending the functionality of the R/3 system to casual users." This global integration strategy by networking the enterprise is viewed as "e-commerce survival". A change management team was commissioned to achieve this end. The numerous requests from various profit centres within the group for similar solutions showed a high level of acceptance from the user communities.

- **To maximise the benefits** the design of intranet interface has to accommodate the least trained employees. Requires concerted corporate focus. Managers and IT views must learn together (fast) to seek new business models. A recognition to create the Internet system as a **learning system**.
- **To minimise the barriers** increase the availability of supplier catalogues. Collaboration between suppliers, to standardise item numbers in catalogues. Easier linking of SAP data to Internet with a greater variety of BAPIs. "We need to understand the environmental factors including IT infrastructure." Corporate paranoia is in the minds of managers and consultants. Change management needs to be addressed and practiced.

B2C & B2B Customers/Partners Online sales Value added products and service

For Scitech the effect of integrating R/3 with Internet improved efficiency aspects of B2B sales worldwide. IT was the main driver in this B2B project. The system was developed to optimise processes between Scitech Computers and its partners and customers. Some 80% of orders (2200 key accounts) are handled by the ordering system with significantly reduced order errors.

<http://charity.org/> chose an application service provider (ASP) for its total IT support. This is the first ASP solution to use the Internet with R/3 in Australian. This infrastructure provided a fully integrated business "back-end" for the organisation's existing Web site, for the online sales of gift cards. It allowed for an improved product range (online), and a new business image. But "how do we let people know we have a web presence?" Some technical issues remain with matching their business processes with R/3.

Using SAP's suite of e-business applications, <http://society.com/> was "able to move its mail order business in a greater variety of directions without having to re-engineer its business processes, eg any time, anywhere". From the feedback through the web site (e-mails 20 to 30 per day), "we are beginning to understand what our members want even though we have not yet delivered this." Some technical problems, eg not enough business application programming interfaces (BAPI)s.

- **To maximise the benefits:** Communication between the two branches is an issue. Be more pro-active by making the web site enjoyable. Utilise synergy between industry networks, email lists, web links, and improve the e-learning capability on the web site. "E-nable" customers in ordering, using more visual power and through the development of an e-community. Empower staff in customer care service. Move from increased efficiency to improved effectiveness.
- **To minimise the barriers:** Publicity via e-mails and online catalogues. Improve the tracking of orders as well as resolve out of stock procedures. Some basic business issues were unresolved. Take charge of the ethical issues in credit taken from members before stock is processed.

Theoretical Framework of e-Business Change Management

In contrast to the West Australian cases the international cases showed signs of a shift from technology driven change to business process change for doing business online. Intranets integrated with SAP R/3 were seen as the first Internet experience. They affected greater awareness of the business environmental factors. "We need to understand the environmental factors including IT infrastructure" (Guha's et al, 1997: p.121).

The relationships presented in the framework (Figure 3) are based on relevant work in organisational change, strategic management innovation, and information systems. The general thesis of the framework is adapted from Guha's et al, (1997) work on "Business Process Change Management".

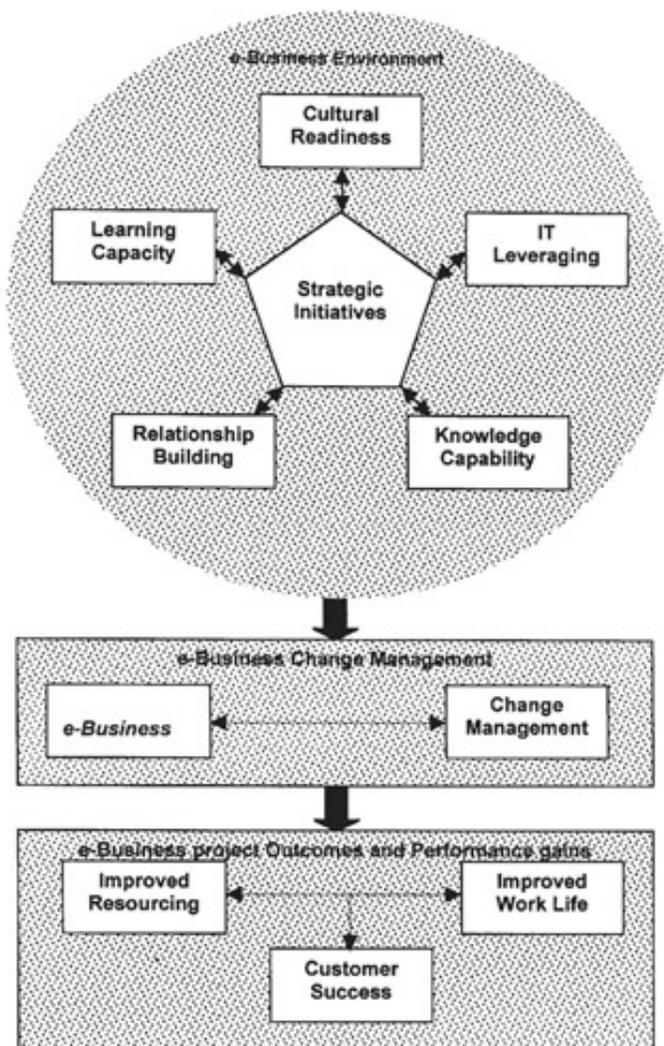




Figure 3: Theoretical Framework of e-Business Change Management (Adapted from Guha et al, 1997)

This framework is used to map this study and as well as a guide for further study, aimed at identifying the facilitators and inhibitors for successful e-ERP implementations across multiple-case studies.

In order to avoid an original IT-centric position, e-business change (e-BC) is defined here as an organisation initiative to design an e-business project to achieve significant (breakthrough) improvements in performance. For example; "quality, responsiveness, cost, flexibility, satisfaction, shareholder value, and other critical e-business measures" (p.121). Such improvements are most likely to be realised through changes in relationships between; management, information, technology, and people; at the level of individual / team, corporate, and community (Venkatraman and Henderson, 1998).

Antecedence of e-Business Change

In Table 2, the initial findings of study are mapped onto components of the e-business framework (Figure 3). This mapping is used to verify and categorise the components of environmental and management factors. For example, only one company <http://o&gas.com/> referred to the need for cultural readiness; to maximise benefits, where as <http://bank.com/> complained about corporate paranoia; to minimise barriers.

Table 2: Summary Map of e-Business Change from Case Studies

Business Framework Components	#1 Bank	#2 Biotec	#3 Charit	#4 Emplo	#5 Engin	#6 Media	#7 O/Gas	#8 Pharm	#9 Scitec	#10 Societ
e-Business Change	Bus back-end	Cost, time saving	e-Bus. image	Admin Cost saving	Staff Mgt saving	e-Com advantage	e-Mkt advantage	Cost, time saving	e-Com advantage	Bus back-end
Environment										
<i>Strategic Initiatives</i>			+ve			+ve			+ & -	-ve
<i>Cultural Readiness</i>	-ve						+ve			
<i>IT Leveragability</i>	+ve			+ve	+ve	+ve			+ve	
<i>Knowledge Capability</i>		+ve					+ & -	+ve		
<i>Relationship building</i>		+ve						+ve		
<i>Learning Capacity</i>	+ve									
Management										
<i>Change Mgt Practice</i>						+ve	+ve			-ve
<i>e-Business Mgt Practice</i>	+ve					+ve			+ve	
Performance Measure										
<i>Working life</i>	+ve				+ve					
<i>Business resourcing</i>		+ve		+ & -		+ve	+ve	+ve	+ve	
<i>Customer interaction</i>			+ & -						+ve	+ & -
Key: -ve = minimise Barriers; +ve = maximise Benefits; +& - = both										

Outcomes and Performance gains

Outcomes of e-business change (e-BC) can be measured at various levels within the broad complex phenomenon of an e-ERP project. In any examination of e-BC outcomes, consideration should be given to; (i) the environmental conditions for change, and (ii) the ability of the organisation to manage change in those conditions (see Table 2).

To address these areas and issues effectively Kaplan and Norton (1992; 1996) offer the use of a balanced scorecard (BSC). The use of BSC for strategic enterprise management is a significant departure from traditional performance management programs that are to financial frameworks. The BSC provides that discipline that helps executive teams to articulate and better understand their strategies. In addition, the BSC enables organisations to introduce a new governance and review process that is focused on strategy and not on tactics. The governance process emphasises learning, team problems solving and

coaching.

More recently, leading firms that have begun to undertake e-BC to meet strategic goals recognise that they only accomplish their objectives through people. If effectively managed, employees should ultimately be more productive in their work tasks and better able to serve customers, suppliers, and business partners. The key constructs that can be probed here are; gaps between effectiveness expectations (goals) and actual performance improvements, eg efficient company resourcing, quality of employee work life, customer satisfaction;^afrom Venkatraman and Henderson's view of "virtual organising", (1998).

FUTURE STUDIES

In the future e-ERP technology will play an integral part in helping established enterprises build and operate B2B e-procurement solutions, that should eventually lead to the development of electronic marketplaces. Also, as e-business adoption becomes common place, corporate portals for empowering employees will be considered as an economic necessity. When these corporate front-end systems begin to look and feel the same, the real competitive advantage will ultimately come from the ERP back-end systems.

The next wave of economic advantage lies in revenue generation from business opportunities in new e-business models. As business strategy shifts from just cost savings to revenue generation, this research framework is recommended as tool for future study of the broad and new complex phenomenon of e-ERP implementations. A candidate area for future research is *e-business change and organisational performance, in ERP environments*.

In the next stage of the study all case organisations will be re-interviewed to gather information that will lead to identifying the facilitators and inhibitors for the success of e-business projects. The measure of success will focus on the outcomes of and performance gains of e-business change. The research challenge, then, is one of leveraging existing theory to circumscribe the research domain for examining diverse attributes of e-business adoption across multiple contexts.

CONCLUSIONS

The chapter reports on the findings from a multi-case study of ERP enabled organisations that have pioneered e-business (e-ERP) projects. The paper reports on a study carried out during 1999 and 2000 on the state of e-business developments within ERP environments. Although these technologies have distinctly different functions, combined they offer a sound infrastructure for doing business on-line. We establish a theoretical conjecture; an e-business project built on the strong foundation of an ERP system, that can provide information for all business partners via the web, and can process incoming information from the customers and suppliers, is much more likely to succeed than one lacking this foundation.

The study was an exploratory investigation into the benefits from extending enterprise wide business systems beyond the organisation. The findings of the preliminary investigation of local Australian SAP sites confirmed the existence of the three generic business-to-business models: (i) B2B_j^a to support information processing and communication, (ii) B2E_j^a to support knowledge sharing, (iii) B2C_j^a to support customer interaction on demand.

Analysis of the findings from interviews of ten overseas SAP sites, highlighted consideration of the environmental conditions and management of e-business change, when implementing e-business projects. For example, the capability to share knowledge, importance of the learning organisation, as well as the role of IT alignment between the ERP and e-business project. The key findings from each case study were mapped onto a theoretical framework, adapted from business process change research to validate an *e-business change* model, for future studies.

This research framework was chosen for its ability to examine complex phenomena. It is seen as evolutionary in nature, and was content driven. In order to avoid an original IT-centric position, we recommend the focus be on managing the change induced by e-business projects. We consider the framework to be a diagnostic tool for identifying factors contributing to success of new business models. It is NOT seen as a prognostic tool. It would appear to have some use by business professionals/consultants in e-business change projects.

REFERENCES

- Ash, C.G. and Rossouw, A. (1999). *Internet enterprise resource planning pilot project: A case for maximising the synergy between teaching, research and industry*. In *Proceedings of Institutions of Higher Learning* CForum at SAPHIRE'99, Singapore, 31 Oct. C3 Nov.
- Boey, P., Grasso, M., Sabatino, G., and Sayeed, I. (1999). *Architecting eBusiness Solutions*, 2(7). <http://www.cutter.com/consortium/freestuff/dcar9907.html>.
- Guha, S., Grover, V., Kettinger, W.J., and Eng, J. T. C. (1997). *Business process change and organisational performance: Exploring an antecedent model*. *Journal of Management Information Systems*, 14(1), 119 C154.
- Hesterbrink, C. (1999). *e-Business and ERP: Bringing two Paradigms together*. *PriceWaterhouse Coopers*, Sept. '99. <http://www.pwc.com/>.
- Kaplan, R. and Norton, D. (1992). *The balanced scorecard* CMeasures that drive performance. *Harvard Business Review*.
- Kaplan, R. and Norton, D. (1996). *The balanced scorecard: Translating strategy into action*. *Harvard Business Review*.
- Manville, B. (1997). *Knowledge Management for the New World of Business*. Malhotra, Y. (Ed.). <http://www.brint.com/km/whatis.htm>.
- NNI. (1998). *Report on Electronic Commerce, Nolan Norton Institute Research, KPMG Australia Sept.'98*. <http://www.kpmg.com.au/>.
- Perez, M., Hantusch, T., and Matzke, B. (1999). *The Sap R/3 System on the Internet*. Reading, MA: Addison-Wesley
- SAP. (1999). *e-Business Solutions via mySAP.com*. <http://www.sap.com/solutions/e-commerce/executiv.htm>.
- Telleen, S. L. (1996). *Intranets and Adaptive Innovation*. <http://www.amdahl.com/doc/products/bsg/intra/adapt.html>.
- Venkatraman, N. Henderson, J.C. (1998). *Real strategies for virtual organising*. *Sloan Management Review*, Fall, 33 C48.

Chapter 3: The Evolution of ERP Systems;^aA Historical Perspective

**Mohammad A. Rashid, Massey University^cAlbany,
New Zealand**

**Liaquat Hossain, Syracuse University,
USA**

**Jon D. Patrick, University of Sydney,
Australia**

ERP Systems are now ubiquitous in large businesses and the current move by vendors is to re-package 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 dataflow 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 need 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 (APICS, 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 & Hillsgersberg, 2000). "One database, one application and a unified interface across the entire enterprise" (Tadger, 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](#).

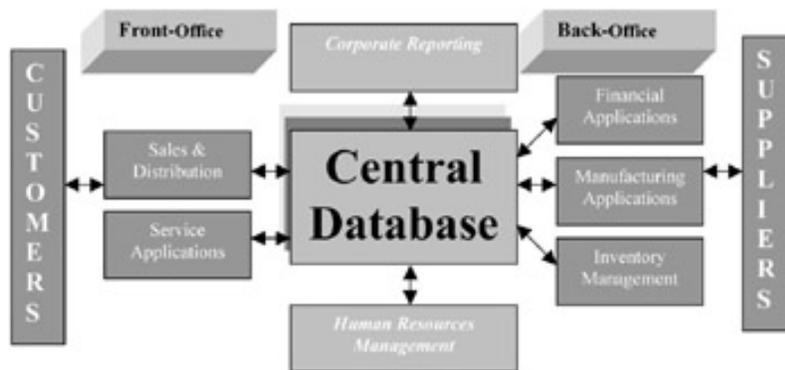


Figure 1: ERP systems concept

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 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, 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 are 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 overcome certain problems and disadvantages listed in [Table 2](#).

Table 1: Advantage 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 organisational decisions.
Easy adaptability	Changes in business processes easy to adapt and restructure.
Improved scalability	Structured and modular design with "add-ons"
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 re-engineering 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 organisation.
Vendor dependence	Single vendor vs multivendor consideration, options for "best of breeds", long term committed support.
Feature and complexity	SRP system may have too many features and modules that the user needs to consider carefully and implement the needful only.
Scalability and global outreach	Look for vendor investment in R&D, long term commitment to product and services, consider Internet-enabled systems.
Extended ERP capability	Consider middle-ware "add-on" facilities and extended modules such as CRM and 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 world-wide 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 percent 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 non-compatible 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 dataflow 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 on-line 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, HP UX systems. SAP AG, the largest ERP vendor provides a number of modules shown in [table 3](#) with its famous R/3 ERP system. 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 <http://mysap.com/>

mySAP Workplace	mySAP E-Procurement	mySAP Human Resources
mySAP Supply Chain Mgmt.	mySAP Product Lifecycle Mgmt.	mySAP Marketplace by SAPMarket
mySAP Customer Relationship Mgmt.	mySAP Business Intelligence	mySAP Hosted Solutions
mySAP Financials	mySAP Mobile Business	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 gets 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, programs acting on data received/transferred from/to the database servers.
- **Database Layer:** Management of the organizations' operational or transactional data including metadata. Mostly employs industry standard RDBMS with structured query language (SQL) provisions.

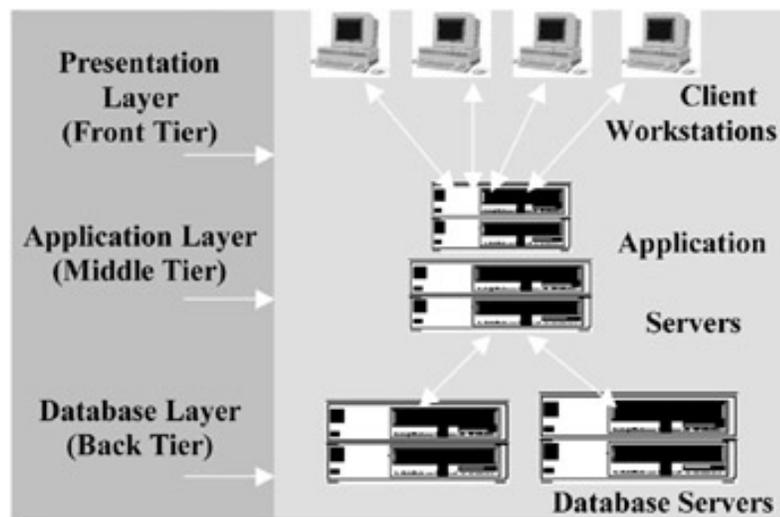


Figure 3: Three-tier ERP systems architecture

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 multibillion 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, <http://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 <http://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's Flagship Product Oracle Applications

Oracle (Oracle, 2001), founded 1977 in the USA, is best known for its database software and related applications, 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. Oracle's 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, Workflow, Systems Administration, Application Development Tools (ADTs), 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 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 that 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's 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%. Baan's revenue in 1998 was roughly \$750 million while facing slight slow down in 1999 started growing again in 2001 with sales up 12% at £7,231 million 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 customer-focused 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 & implementation, Planning, Sales, Service & Maintenance and Business portals, Collaborative commerce and Business Intelligence. Baan'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.'s Flagship Product *OneWorld*

J.D. Edwards was founded in 1977 in Denver (co-founded by Jack Thompson, Dan 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, OneWorld 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 modules. J.D. Edwards' revenue jumped to \$944 million in 1999 from \$120 million in 1992 having more than 5,000 customers in over 100 countries. 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 the 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 E-business backbone for organizations doing on-line business transactions over the Internet. Internet-based solutions are destined to improve customer satisfaction, increase marketing and sales opportunities, expand distribution channels, 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 the 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 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 <http://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.

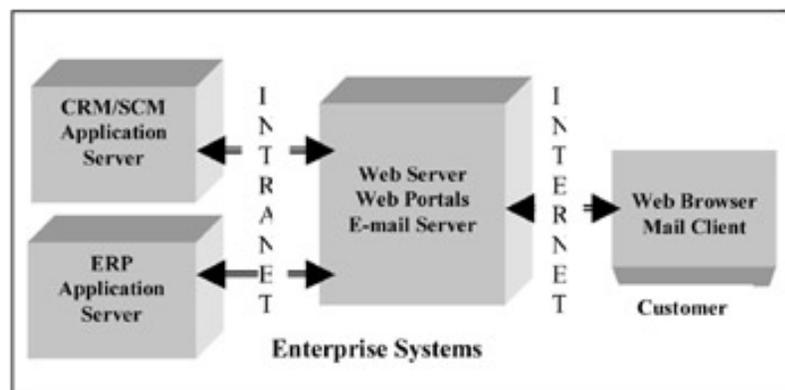


Figure 4: Web-enabled extended ERP system

Examples of extended ERP system may be Oracle's e-business suite of ERP system 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 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 re-engineered to OneWorld Xe ("Xe" stands for "extended enterprise") that enables 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 Intenia International AB [Intenia, 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 system. Hence the major providers are representatives of certain industries as much as competitors in a common market place. 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.

REFERENCES

APICS (2001). *American Production and Inventory Control Society (APICS)*, <http://www.apics.org/>

Armstrong, A., & Hagel, J. III. (1996). *The Real Value of On-line Communities*. *Harvard Business Review*, 74(3), pp.134-141.

Bakos, Y. (1998). *The Emerging Role of Electronic Marketplaces on the Internet*. *Communications of the ACM*, 41(8), pp.35-42

Bhattacharjee, A. (1999). *SAP Implementation at Geneva Chemical*, <http://www.cob.asu.edu/fac/ABhatt/cases/Geneva.pdf>

Bingi, P., Sharma, M. K. and Godla, J. K. (1999). *Critical Issues Affecting An ERP Implementation*. *Information Systems Management*, 16(3), pp.7-14.

Broatch, M. (2001). *Making the ERP connection*. *Computerworld New Zealand*, July, 2001

Butler, Martin, (1999). *CRM isn't Magic Bullet for Customer Loyalty*. *Computerworld*. 33(34), p.34.

Davenport, T.H., (1998). *Putting the Enterprise into the Enterprise System*. *Harvard Business Review*, 76(3), pp.121-131

Davenport, T.H (2000). *Mission Critical: Realizing the Promise of Enterprise Systems*. Harvard Business School Press. Boston, MA, 2000.

Holland, C. and Light, B. (1999). *A Critical Success Factors Model For ERP Implementation*. *IEEE Software*, May/June, pp.30-36.

Kalakota, R. and Robinson, M., (1999). *e-Business Roadmap for Success*, Addison-Wesley, 1999

Kraft, C.L. (2001), *Executive ERP*, <http://www.oracle.com/oramag/profit/99-May/index.html?p29ind.html>

Kumar, K. and Van Hillsgersberg, J., (2000). *ERP Experiences and Evolution*. *Communications of the ACM*, 43(4), pp.23-26.

Lawton, G. (2000), *Integrating ERP and CRM Via the Web*, *SW Expert*, 2000.

Li, C. (1999). *ERP Packages: What's Next?*. *Information Systems Management*, (16:3), pp.31-35.

Norris, G., Dunleavy, J., Hurley, J.R., Ballis, D. and Hartley, K.M., (2000). *E-Business and ERP: Transforming the Enterprise*. John Wiley & Sons, USA

O'Leary, D.E., (2000). *Enterprise Resource Planning Systems : Systems, Life Cycle, Electronic Commerce, and Risk*. Cambridge University Press, UK.

Shields, M.G., (2001). *E-Business and ERP: Rapid Implementation and Project Planning*. John Wiley & Sons, USA

Tadger, R., (1998). *Enterprise Resource Planning*. *Internetweek*, Manhasset, Apr 13, 1998.

- Baan (2001): <http://www.baan.com/>
- IBM (2001): <http://www.ibm.com/erp>
- Intenia (2001): <http://www.intenia.com/>
- JD Edwards (2001): <http://www.jdedwards.com/>
- Oracle (2001): <http://www.oracle.com/>
- Oracle (2001): http://www.oracle.com/fastforward/site_map.html
- Oracle (2001): http://www.oracle.com/applications/site_map.html
- PeopleSoft (2001): <http://www.peoplesoft.com/>
- SAP (2001): <http://www.sap-ag.de/>
- SAP (2001): <http://www.sap.com/>
- SAP (2001): <http://www.mysap.com/>

Chapter 4: Towards an ERP Life-Cycle Costs Model

José Manuel Esteves, Universitat Politècnica de Catalunya,
Spain
João Álvaro Carvalho, Universidade do Minho,
Portugal
Aldemar A. Santos, Universidade Federal de Pernambuco,
Brasil

Many organizations have adopted ERP systems, but most of them are not aware of the total costs associated with them, and they only consider the costs related with the software acquisition. This article is an exploratory study that sets out to identify other costs related to ERP systems during their life-cycle. Through the different phases of the life-cycle we define and categorize the various costs. The costs were classified as tangible and intangible. We also describe a case study where the costs related to the three initial phases of the life-cycle were analyzed: acquisition, implementation, and usage and maintenance. Finally, some conclusions are drawn and we pose some research questions for further work.

INTRODUCTION

AMR research Inc., a leading enterprise in market analysis, expects that the market for *software enterprise resource planning* (ERP) will grow at a rate of 37% until 2003 (Caruso, 1998). Forecasts show that the ERP market will rise to \$66 billions (Hangendorf, 1999), and that ERP will remain one of the biggest in growth with more influence in the software industry, quotes AMR. Nowadays, the ERP products and services industry is one of the most promising.

Through the usage of ERP systems such as SAP, BAAN, Peoplesoft and Oracle, organizations try to integrate the information-flow of the different business areas and, at the same time, improve efficiency and reduce costs. Theoretically, these integrated systems provide large functionality in terms of problem-solving associated with data-flow when they are integrated with different software systems.

Some critiques of ERP systems focus essentially the high costs of ERP projects, the high failure-rates and their complexity, which makes it difficult for users to perceive the advantages and the opportunities of these systems.

ERP systems demand a large investment at the economic, human-resource and organizational levels. This investment is made not only in the initial phase but throughout their life-cycle. Thus, this study is intended to analyze the necessary investment to integrate an ERP system during its life.

The chapter was structured in the following way. First, the ERP life-cycle is defined. Next, the different costs are defined and analyzed for each phase. Then, a case study of a Portuguese company is described, and the costs of the three initial phases were studied. Finally, we present some considerations for future work.

ERP SYSTEMS OVERVIEW

Typically, an ERP system is a software package composed of several modules, such as production, sales, finance and human resources, providing for the horizontal integration of data across an organization and through its business processes. These software packages can be customized to address the specific needs of an organization (Esteves and Pastor, 1999a).

According to Davenport (1998), an ERP system is a generic solution, the design of which reflects a series of conclusions (best practices) about the way organizations work. Thus, and contrary to the proprietary systems developed according to the specific requirements of an organization, the ERP systems are generic in nature. They impose their own logic in respect of strategy, culture and structure of an organization, many times forcing changes in the way of doing business (SAS Institute, 1998).

The idea behind ERP systems is that the software needs to represent the whole of the business process chain. With an ERP system, the financial department can close a paying account as soon as the warehouse clerk confirms the reception of goods. This is done with minimal human intervention and without paper documents flowing through the organization (Slater, 1999).

Ross and Vitale (1998), define six common motivations to adopt an ERP system: need for a common platform, process improvement, data visibility, operating cost reductions, increased customer responsiveness and, improved strategic decisionmaking.

One of the issues in the ERP systems area is that of determining if the investment made will be compensated in the future. A survey of Meta Group Inc (Craig 1999), shows that, typically, in financial terms, ERP projects cost more than the expected benefits. These are close to academic studies on this object. But there are some suggestions that, financial terms and other strategic benefits should be considered. This issue is included in broader discussions about investment in information systems and their performance (Bender, 1986; Brynjolfsson and Hitt, 1994; Harris and Katz, 1988). Some authors found no or little relationship between them (Strassmann, 1990, 1999; Turner, 1985), while others concluded that the investment in information systems has been detrimental to organizations (Roach, 1988).

ERP systems demand high investment at the economic, human-resource and organizational levels. These investments are made not only in the initial phase but throughout their life-cycle. Thus, this study analyzes the necessary investments for the integration of an ERP system during its existence, along with an analysis of the costs associated with each phase.

ERP SYSTEMS LIFE-CYCLE

To define the life-cycle model we use a simplified version of the model proposed by Esteves and Pastor (1999a, 1999b). This model is structured in phases and dimensions. Here, we only make reference to the phases as the different stages of the life-cycle of an ERP system in an organization. Next, we describe each phase, i.e., adoption, acquisition, implementation, usage and maintenance, evolution and retirement.

Adoption decision phase During this phase managers examine the need for a new ERP system while selecting the general information system approach that will best address the critical business challenges and improve the organizational strategy. This decision phase includes the definition of system requirements, its goals and benefits, and an analysis of the impact of adoption at a business and organizational level.

Acquisition phase This phase consists on the selection of a ERP product that best fits the requirements of the organization, thus minimizing the need for customization. A consulting company is also selected to help in the next phases of the ERP life-cycle especially in the implementation phase. Factors such as price, training and maintenance services are analyzed and, the contractual agreement is defined. In this phase, it is also important to make an analysis of the return on investment of the selected product.

Implementation phase This phase include the customization or parameterization and adaptation of the ERP package to the needs of the organization. Usually this task is made with the help of consultants who provide implementation methodologies, know-how and training.

Use and maintenance phase This phase covers the personal of time where the ERP product is selected in a way that returns benefits and minimizes disruption. During this phase, one must be aware of the aspects related to functionality, usability and adequacy to the organizational and business processes. Once a system is implemented, it must be maintained, because malfunctions have to be corrected, special optimization requests have to be met, and general systems improvements have to be made.

Evolution phase This phase corresponds to the integration of more capabilities into the ERP system, providing new benefits, such as advanced planning and scheduling, supply-chain management, customer relationship management, workflow, and expanding the frontiers to external collaboration with other partners.

Retirement phase This phase corresponds to the stage when, with the appearance of new technologies or the inadequacy of the ERP system or approach to the business needs, managers decide if they will substitute the ERP software with other information system approach more adequate to the organizational needs of the moment.

COSTS ALONG THE ERP LIFE-CYCLE

A bibliographical analysis of academic publications on ERP systems shows the lack of studies in this field. Based on published case studies and literature review related to the cost analysis of information systems, we developed a structure of costs along the ERP life-cycle.

Table 1 summarizes the cost items, where costs were classified as tangible or intangible. Thus, tangible costs are the costs that can be measured in a direct way, taking always into account that, sometimes, tangible costs cannot be measured in monetary terms. Intangible costs are those costs that are difficult to be measured in a direct way, since they refer to vague concepts, as illustrated in table 1. Next, we describe in detail each phase and related costs.

Table 1: Costs items along the ERP life-cycle

Phase	Tangible Costs	Intangible Costs
Adoption		Decision making costs
Acquisition	Consultancy Hardware Software licenses	Decision making costs Opportunity costs
Implementation	Consultancy Training Human resources System specification	Customization, conversion and da Time dedicated by staff Business process re.engineering
Usage and Maintenance	System Reconfiguration System adaptation Cost of system failure	Indirect costs of system failure Lost of competitiveness
Evolution	Cost of new applications	
Retirement		Opportunity costs Decision making costs

ADOPTION

Intangible Costs

Decision-Making Costs. This phase is perhaps the phase that has the least associated costs, because it represents only the decision to adopt or not an ERP system. The associated cost is essentially the time spent by managers in the decision-making task. In the context of the decision-making process, the concept of avoidable costs is used to define the costs that can be eliminated when we opt for a specific choice or solution. The unavoidable costs refer to the costs that we cannot eliminate.

ACQUISITION

Tangible Costs

Consultancy Costs. Consultants help with knowledge and experience in the selection of the ERP system most adequate to the organizational needs, and they help in the implementation phase. They also act as mediators between the ERP provider and the organization. Analysts are unanimous in stating that the costs related to consultancy are the highest for an ERP system.

Hardware Costs. Acquisition of an ERP system implies changes in the existing hardware infrastructure. These changes can vary from a change and/or actualization of the actual hardware infrastructure to the complete installation of a new hardware infrastructure. Hardware needs must not be forgotten due to the fact that the new hardware infrastructure must have the maximal performance to provide access in real time to databases and the ERP system modules. Aspects such as network-communication capacity, servers and processing-speed rates are important.

Software Licences. After the selection of ERP software, there is the need to make an agreement contract. The cost of these contract can be calculated in several ways. Some contract consider the number of licenses and the number of users, while others include factors such as organization benefits and number of employees. Usually, providers offer price reductions depending on the number of modules acquired and the acquisition of extended applications and the purchase of maintenance services and upgrades of software.

Intangible Costs

Decision-Making Costs. In the acquisition phase decision-making costs must be analyzed again. The main decision consists of the selection of the ERP system that best addresses the organization needs.

Opportunity Costs. These costs measure the opportunity that is lost or is sacrificed when an option is abandoned. The analysis of the several ERP systems that exist in the market should take into account these costs.

Analysts recommend that at this point a return on investment (ROI) study should be done. The ROI has two important elements: the "how much" and the "when." The "how much" element represents the benefits created by the investment, and the "when" represents the period of investment return.

IMPLEMENTATION

Tangible Costs

Consultancy Costs. Most organization use consultants to implement the ERP system, due to the fact that they don't have the technical knowledge in-house to complete this process. Consultants incorporate knowledge, experience, implementation methodologies, and training programs for users. They also help reengineering the organization and its business processes.

Training Costs. Here, we include the training of a project team and the end users. These costs are usually high because users need to learn a set of new processes and not just the usage of a new software application. To minimize these training costs, there presently exist internet-based tools or video-conference tools that reduce the number of trainers and have a larger scope of training.

Human-Resources Costs. The costs associated with the project team have a high weight. They are expert professionals and their price per hour is high and must be quantified. Sometimes there is the need to recruit these human resources from outside.

System-Specification Costs. These costs refer not only to the number of human-resource hours spent on this task but also the acquisition of tools and instruments (denominated enterprise modelling tools) that help to make specific the necessary business vision.

Intangible Costs

Customization, conversion and data analysis. The effort made in the software customization and adaptation to organization needs is usually not measured, except in terms of time. The data to be inserted in the new system constitutes a heavy burden to the project costs. The data converted from other systems and the new ones have to be verified due to inconsistencies, because usually they are not adequate to the new formats. Usually, there is the need to insert new data in the new system

Time of dedicated staff. The project team and staff have to keep many times their work and make the tasks related with the project. The costs associated with this effort and the respective loss of efficiency are not usually measured. The option of keeping them totally dedicated to the project could result in the recruitment of personnel, whose costs are measurable.

Business-process re-engineering cost. Forrester Research Inc (Koch, 1997) estimated in 1997 that in a typical SAP installation, more than 50% of the implementation budget is spent in business process re-engineering. The implementation of an ERP system means in many cases a radical change in the organization business processes, forcing changes in organizational flows and in organizational structures.

USAGE AND MAINTENANCE

Tangible Costs

System reconfiguration. Usually, after ERP-system implementation some inefficiencies appear in its operation, which requires an adjustment to the ERP configuration. Reporting functions are particularly sensitive to reconfiguration needs.

System Adaptations. Organizations change over time, so there is always therefore the need to adapt the systems to whatever changes have been made. The introduction of new information flows and new business processes influence the ERP system usage and performance.

System-failure costs. Failure costs refer to the costs arising from ERP-system break-downs. In big organizations the direct costs are very high, because orders cannot be satisfied, stocks cannot be updated and in certain cases these failures cause a total disruption of the organization's business.

Intangible Costs

Indirect costs of system failure. System failures cause many indirect costs, such as loss of access to vital information, loss of customer loyalty, or the ability to survive in the business (Uram, 1999).

Loss of competitiveness. A common criticism of ERP systems is the standardization of business models through the imposition of ERP models. Most organizations adopt these business models to facilitate the software implementation and they may thereby lose competitive advantages over other organizations. These changes should be measured in economic terms.

EVOLUTION

Cost of new applications. In this phase the main costs are related to the purchase and implementation of new applications, such as advanced planning and scheduling, customer relationship and management, workflow, e-commerce, etc.

RETIREMENT

Here, the opportunity and decision-making costs repeat and all the tangible costs related with software. When this phase is reached, it is expected that the original investment was been recovered. In cases of abandonment (in implementation phase, for instance), the associated costs can constitute high losses, as happened to the FoxMeyer company (Scott, 1999). The company imputed its bankruptcy to the investment made in an ERP system.

CASE STUDY

In this section, we describe the case of a company that implemented the SAP R/3 system.

It was not possible to find a case study with the whole ERP costs life-cycle. Most organizations only analyze the costs relating to the implementation phase, probably due to the fact that the values in this phase are high. Next, we describe the different costs associated with the integration of a SAP R/3 system, the top ERP product worldwide.

"ABC" (a fictitious name) is a Portuguese medium-sized company engaged in financial services, and is presently in the usage and maintenance phase of the SAP system. The company has experienced high profitability growth over the last few years and intends to improve the services to its customers and optimize its business processes. This motivated the adoption of SAP R/3 system, with the implementation made last year.

The implementation phase is divided in three stages: development, test and exploitation. In this company, part of the costs related to tests are divided between the development and exploitation stages. The initial findings obtained in the case study demonstrate the complexity associated with the implementation phase. [Table 2](#) shows the costs found in the case study analysis.

Table 2: Costs of adoption of SAP R/3 system in a Portuguese enterprise.

Phase	Task/Costs (in dollars)
Acquisition	SAP R/3 licences : 428.077
Implementation	Technical attendance during the project: 14.000 Consultancy: 59.090 Training: 55.681 Development: <i>software</i> SAP installation : 8.272 Acquisition of development <i>Hardware</i> : 39.950 Implementation of financial, logistic and human resources modules: 872.795 Tests: Internal human resources costs: 94.545 Acquisition of hardware to make tests: 9.022 Exploitation: Aquisição de <i>Hardware</i> de exploração : 184.718
Usage and Maintenance	SAP Licences (annual value): 64.213
Total	

The costs of licenses, hardware, implementation training and consultancy were spread out over two years. The total cost at the end of the first year was \$1,810,412. The analysis of the values shown in [table 2](#) shows that the implementation phase is the one that incurred the greatest costs, at 72.8%, while 23.6% and 3.6% of the total expenditure may be apportioned to the acquisition and the usage and maintenance phases, respectively.

Training represents 4.2% of the costs associated with the implementation, a value that is low when compared to that of a typical implementation phase. According to Gartner Group and International Data Corp, the training costs constitute at least 15% of the implementation budget (Marion, 1998). This lower value of 4.2% can be explained in part because some of the training was offered by the consultancy company.

Hardware represents 17.7% of the implementation costs. The company needed to re-structure its computer network and, in addition, needed to purchase some hardware, specifically to facilitate the implementation process. The company opted to charge all the hardware costs to this phase, without discriminate any value in acquisition phase.

Software costs at the end of the first year were 27.2% of the total costs. This value is nearly that defined by Kale, set at 30%, for a typical SAP project (Kale, 2000).

Consultancy costs have the value of \$59,090, but there are some hidden consultancy costs included in the implementation phase, namely in the implementation of the SAP modules, and we note that these costs are globally high.

Relative to the usage and maintenance phase, only the costs of the software licenses were measured. This cost is not fully accurate, because the task of parameterization of reports was performed and the database was upgraded, but these costs were not measured.

Managers of ERP projects point out the need to make a schedule of the investments needed, mainly during the implementation phase, because the lack of economic resources in this phase can make the realization of goals difficult (especially the period of implementation). Thus, they suggest that the financial department of the organization should approve and follow the investment plan of the ERP system.

ABC organization costs structure is the same as defined in our model in relation with tangible costs. The organization did not evaluate the intangible costs. The organization plans to adopt (or develop) an ERP costs model with more accuracy than the actual structure.

CONCLUSIONS

This exploratory study tried to analyze the costs associated with ERP systems. The study presents a list of costs that demonstrate that this type of system has a strong organizational perspective, and therefore the costs associated with this perspective should be taken into account and measured. The list does not intend to be exhaustive but attempts to give a general view of the whole ERP lifecycle.

The case study described shows that most costs are spend in the implementation phase in terms of costs in an ERP system, mainly, the consultancy and hardware costs. Thus, there is the need to analyze these costs because they can increase the initial budget, if the changes in the existing organization hardware were not designed according to the ERP needs.

The next step in this research will be the validation of the cost model proposed in this article through case study approach. Other pertinent issues for further research are:

- What are the benefits after an ERP implementation?
- How do ERP implementation costs affect organizations?
- How should TCO (total cost of ownership) of an ERP system be defined?
- What are the elements of these costs?
- Have the ERP-system expectations been realized?

In conclusion, we think that there are many things to analyze, evaluate and develop in future studies about costs and ERP systems, including procedures for benchmarking.

REFERENCES

- Bender, D. (1986). *Financial impact of information processing*. *Journal of Management Information Systems*, 3(2), 232-238.
- Brynjolfsson, E. and Hitt, L. (1984). *Paradox lost? Firm-level evidence of high returns to information systems spending*. Working Paper Number 162, The Center for Coordination Science, MIT Sloan School.
- Caruso, D. (1998). *ERP vendors*. CAMR Research's Top 20 Roundup, the Report on Enterprise Applications. AMR Research Inc., (Primeira edição 1998), 2.
- Davenport, T. H. (1998). *Putting the enterprise into the enterprise system era*. *Harvard Business Review*. July-August, 121-131.
- Esteves, J. and Pastor, J. A. (1999a). *An ERP life-cycle-based research agenda*. *First International Workshop on Enterprise Management Resource and Planning Systems (EMRPS)*, 359-371. Veneza, Itália.
- Esteves, J. and Pastor, J. A. (1999b). *El ciclo de vida de los sistemas ERP*. *Revista Datamation, versão espanhola, edição especial*, December.
- Hagendorf, J. (1999). *ERP partnerships remain elusive for distributors*. *Computer Reseller News*, December 06, 872. <http://www.techweb.com/se/directlink.cgi?CRN19991206S0055>.
- Harris, S. E. and Katz, J. L. (1988). *Profitability and information technology capital intensity in the insurance industry*. *Proceedings de Twenty-first Annual International Conference on System Sciences*, IV, 124-130.
- Kale, V. (2000). *Implementing SAP R/3: The guide for business and technology managers*. SAMS Publications, January, 115.
- Koch, C. (1997). *Lump it and like it*. *CIO Magazine*, April. http://www.cio.com/archive/041597_lump_print.html.
- Marion L. (1998). *The 15% solution*. *revista Datamation*, May. <http://www.datamation.com/PlugIn/workbench/entapp/stories/05erp.html>.
- Roach, S. S. (1988). *Technology and the service sector: The hidden competitive challenge*. *Technological Forecasting and Social Change*, 34(4), December, 387-403.
- Ross J. and Vitale M. (1998). *The ERP revolution: Surviving versus thriving*. Research paper, Center for Information Systems research, Sloan School of Management, MIT.
- SAS Institute. (1998). *Increasing ROI from ERP Systems*. SAS Institute Inc., <http://www.sas.com/new/feature/06dec98/ERP.html>.
- Scott, J. E. (1999). *The FoxMeyer Drug's bankruptcy: Was it a failure of ERP?* *Americas Conference on Information Systems (AMCIS)*, Milwaukee, USA.
- Slater, D. (1999). *An ERP package for you_i - and you_i - and you_i - and even you*. *CIO Magazine*, February.
- Stedman, C. (1999). *Survey: ERP costs more than measurable roi*. *Computerworld*, May, <http://www2.computerworld.com/home/print.nsf/all/9904059CFE>.
- Strassmann, P. (1990). *The Business Value of Computers*. New Canaan, CT: The Information

Economics Press.

Strassmann, P. (1999). *The search for productivity*. *Computerworld*, 33(32), 52, August.

Turner, J. (1985). *Organizational performance, size and the use of data processing resources*. *Proceedings of the Third International Conference on Information Systems*, Ann Arbor, MI, 1982. Versão disponível no Centre for Research on Information Systems (CRIS), Leonard N. Stern School of Business, NYU, Working Paper #58, 1985.

Uram, M. (1999). *Speeding ROI, decreasing TCO for ERP building IT infrastructure for enterprise applications*. *Proceedings da conferência ERPWorld'99*.

Chapter 5: The Myth of Integration; A Case Study of an ERP Implementation

Rosendo Alvarez, University of Massachusetts, USA

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 "myth-making" process. A case study of an implementation at a large non-profit 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 often times failed ERP implementations (Knorr, 1999, Deutsch, 1998, 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 8000 to 10,000 configuration tables and 800 to 1000 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, 1/27/97) 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 myth-making. 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 non-rational, are linked to seemingly objective and rational goals (Tolbert, 1988). This chapter argues that myth-making 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 myth-making 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; Kwon & Zmud, 1987; Iivari, Hirschheim, & Klein, 2000). 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 "non-technical" issues are major contributors to systems failures. Another related stream of research has recognized the importance of an organizations' 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 non-rational 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 & Roland, 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 myth-making 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 sensemaking 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 myth-making.

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 (Meyers, 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 and 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 1184 and staff of approximately 3600. 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 five million dollars 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 fifteen 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 inhouse. 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. The following illustrates how groups, composed of individuals from various offices, were structured to articulate their information requirements, issue an RFP and select a new ERP.

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 six 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.



Figure 2: Structure of CIS project

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 the 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 re-construct existing organizational values. Specifically, the myth of integration was created through delegitimizing 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 are 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 FTE 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 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 thirty 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, 1/ 25/91, p.6).

Clearly, there was a growing sense of dissatisfaction with the information system product and services provided by SAIS. Greenwood and Hinnings (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 delegitimize the SAIS arrangement. That is, groups began to recognize that 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, 6/29/92, 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 fifteen 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, 6/29/92, 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 delegitimize 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

Myth-making 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 re-constitute and re-affirm the organizational value of integration. In this sense, myth-making 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 lifecycle, 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 ten 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 as 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 myth-making 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 seam time to re-constitute 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 percent (n=86).

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

1. 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 percent 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 response to open ended question

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

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 ideal system that would be integrated and also accessible. In open-ended questions respondents used language that indicated that 46.5 percent believed the new system was either an integrated system or would allow for integration or interconnection. Yet, only 13.4 percent 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 the 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 co-workers.

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 do perform their work so this question was discarded. The additional questions were summed for each responded. 54.7 percent of the respondents stated that they had received most of their information about the ERP system from co-workers and no where else. These respondents had not attended public performances by project team member 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 myth-making 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, myth-making 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 implementation 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 myth-making 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 myth-making 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, myth-making 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, myth-making 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 analyst, no longer as engineer or scientist, but rather "analyst as anthropologist" (Alvarez & Urla, forthcoming) who faithfully records and pays attention to myths conveyed by organizational members.

REFERENCES

- Ahn, J. & Skudlark, A. (1997). *Resolving conflict of interests in the process of an information system implementation for advanced telecommunication services*. *Journal of Information Technology*, 12, 3^oC13.
- Alvarez, R. & Urla, J. (Forthcoming). *Tell me a good story: Using narrative analysis to examine information requirements' interviews during an ERP implementation*. *Database*
- Alvesson, M. & Skoldberg, K. (2000). *Reflexive methodology: New vistas for qualitative research*. London: Sage.
- Barley, S. R. (1986). *Technology as an occasion for structuring: Evidence from observations of CT scanners and the social order of radiology departments*. *Administrative Science Quarterly*, 21, 78^oC108.
- Bloomfield, B.P. & Coombs, R. (1992). *Information technology, control and power: The centralization and decentralization debate revisited*. *Journal of Management Studies*, 24 (4), 459^oC484.
- Boje, D. M. (1991). *The storytelling organization: A study of story performance in an office-supply firm*. *Administrative Science Quarterly*, 36 (1), 106^oC128.
- Boje, D. M., Fedor, D. B. & Rowland, K.M. (1982). *Myth making: A qualitative step in OD interventions*. *Journal of Applied Behavioral Science*, 18 (1), 17^oC28.
- Boland, R. Jr. & Tenkasi R. (1995). *Perspective making and perspective taking in communities of knowing*. *Organization Science*, 6 (4), 350^oC372.
- Brown, A. (1994). *Politics, symbolic actions and myth making in pursuit of legitimacy*. *Organization Studies*, 15 (6), 861^oC878.
- Brown, A. (1998). *Narrative, politics and legitimacy in an IT implementation*. *Journal of Management Studies*, 35 (1), 35^oC59.
- Brown, A. & Jones, M.R. (1998). *Doomed to failure: Narratives of inevitability and conspiracy in a failed IS project*. *Organization Science*, 19 (1), 73^oC88.
- Bruner, J., (1990). *The narrative construction of reality*. *Critical Inquiry*, 18, 1^oC21.
- Computerworld Briefs, January 27, 1997, 31 (4), 47.
- Coombs, R., Knights, D. & Willmott, H. C. (1992). *Culture, control and competition: Toward a conceptual framework for the study of information technology in organizations*. *Organization Studies*, 13 (1), 51^oC72.
- Cooper, R. B. & Zmud, R. W. (1990). *Information technology implementation research: A technological diffusion approach*. *Management Science*, 36 (2), 123^oC139.
- Davidson, E.J. (1997). *Examining project history narratives: An analytic approach*. In A.S. Lee, J. Liebenau, & J.I. DeGross, (Eds.), *Proceedings of the IFIP TC8 WG8.2 International Conference on Information Systems and Qualitative Research* (pp. 123^oC148). Philadelphia, PA.
- Deutsch, C. H. (1998). *Software that can make a grown company cry*. *New York Times*, New York, Nov 8.
- Doherty, N. F. & King, M. (1998). *The importance of organizational issues in systems*

development. *Information Technology and People*, 11 (2), 104-C123.

Dube, L. & Robey, D. (1999). *Software stories: Three cultural perspectives on the organizational practices of software development*. *Accounting, Management and Information Technology*, 9, 223-C259.

Eisenhardt, K. (1989). *Building theories from case study research*. *Academy of Management Review*, 14 (4), 532-C550.

Evered, R. & Louis, M. (1981). *Alternative perspectives in the organizational sciences: Inquiry from the inside and inquiry from the outside*. *Academy of Management Review*, 6, 385-C396.

Ewusi-Mensah, K. & Przasnyski, Z. (1991). *On information systems project abandonment: An exploratory study of organizational practices*. *MIS Quarterly*, 15 (1), 67-C85.

Filby, I. & Willmott, H. (1988). *Ideologies and contradictions in a public relations department: The seduction and impotence of living myth*. *Organization Studies*, 9 (3), 335-C349.

Gabriel, Y. (1991). *Turning facts into stories and stories into facts: A hermeneutic exploration of organizational folklore*. *Human Relations*, 44 (8), 857-C875.

Geertz, C. (1973). *The interpretation of cultures*. New York: Basic Books.

Glaser, B. G. & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research*. New York: Aldine.

Glass, R.L. (1998). *Enterprise resource planning: Breakthrough and/or term problem?* *Database*, 29 (2), 14-C16.

Greenwood, R. & Hinings C.R.. (1996). *Understanding radical organizational change: Bringing together the old and the new institutionalism*. *Academy of Management Review*, 21 (4), 1022-C1054.

Hirschheim, R. & Newman, M. (1991). *Symbolism and information systems development: Myth, metaphor and magic*. *Information Systems Research*, 2 (1), 29-C62.

Hirt, S. G. & Swanson, E. B. (1999). *Adopting SAP at Siemens power corporation*. *Journal of Information Technology*, 14 (3), 243-C251.

Holland, C.P. & Light, B. (1999). *A critical success factors model for ERP implementation*. *IEEE Software*, 16 (3), 30-C38.

Hornby, C., Clegg, C., Robson, J., McClaren, C. Richardson, S. & O'Brien, P. (1992). *Human and organizational issues in information systems development*. *Behaviour & Information Technology*, 11 (3), 160-C74.

Iivari, J. (1992). *The organizational fit of information systems*, *Journal of Information Systems*, 2, 3-C29

Iivari J., Hirschheim, R. & Klein, H. K. (2000). *A dynamic framework for classifying information systems development methodologies and approaches*, *Journal of Management Information Systems*, 17 (3), 179.

Knights, D. & Murray, F. (1994). *Managers divided: Organizational politics and information technology management*. New York: John Wiley and Sons.

Knorr, E. (1999). *ERP's rough waters*. *Upside Today*, November 18.

Kwon, T. H. & Zmud, R. W. (1987). *Unifying the fragmented models of information systems implementation*. In R. J. Boland & R. Hirschheim (Eds.), *Critical Issues in Information Systems Research* (pp. 227-C262). New York: John Wiley.

- Lawrence, P.R. & Lorsch, J.W. (1967). *Organization and Environment*. Cambridge: Harvard University Press.
- Lucas, H. C. (1975). *Why Information Systems Fail*. New York: Columbia University Press.
- Malaney, G. & Alvarez, R. (1996). *Designing and managing a division-wide network: Technical and organizational issues*. In L. Lloyd (Ed.), *Administrative Computing in Higher Education* (pp. 73-83). Medford, NJ: Information Today.
- Marshall C. & Rossman, G. B. (1995). *Designing qualitative research* (2nd ed.). Thousand Oaks, CA: Sage.
- Martin, J. & Meyerson, D. (1988). *Organizational cultures and the denial, channeling and acknowledgement of ambiguity*. In L. Pondy, R. Boland Jr., & H. Thomas (Eds.), *Managing Ambiguity and Change* (pp. 93-125). New York: Wiley.
- Meyer, J. W. & Rowan, B. (1997). *Institutionalized organizations: Formal structure and myth and ceremony*. *American Journal of Sociology*, 83, 340-363.
- Meyers, M. D. (1995). *Dialectical hermeneutics: A theoretical framework for the implementation of information systems*. *Information Systems Journal*, 5, 51-70.
- Miles, M.B. & Huberman, A.M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.) Thousand Oaks, CA: Sage.
- Mumby, D. K. (1987). *The political functions of narrative in organizations*. *Communication Monographs*, 54, 113-127.
- Oliver, C. (1992). *The antecedents of deinstitutionalization*. *Organization Studies*, 13 (4), 563-588.
- Orlikowski, W. J. (1992). *The duality of technology: Rethinking the concept of technology in organizations*. *Organization Science*, 3 (3), 398-428.
- Putnam, L.L. (1983). *The interpretive perspective, an alternative to functionalism*. In L.L. Putnam & M. E. Pacanowsky (Eds.), *Communication in Organizations, an Interpretive Approach* (pp. 31-54). Beverly Hills, CA, Sage.
- Quaid, M. (1993). *Job evaluation as myth*. *Journal of Management Studies*, 30 (2), 239-260.
- Reissman, C. K. (1993). *Narrative Analysis*. Newbury Park: Sage.
- Robey, D. & Markus, M.L. (1984). *Rituals in information systems design*. *MIS Quarterly*, 8, 5-15.
- Robey, D. & Newman, M. (1996). *Sequential patterns of information systems development: An application of a social process model*. *ACM Transactions on Information Systems*, 14 (1), 30-63.
- Sabherwal, R, & Robey, D. (1995). *Reconciling variance and process strategies for studying information system development*. *Information Systems Research*, 6 (4), 303-327.
- Scott, J. E. & Kaindl, L. (2000). *Enhancing functionality in an enterprise software package*. *Information & Management*, 37 (3), 111-122.
- Scott, W. R. (1987). *The adolescence of institutional theory*. *Administrative Science Quarterly*, 32, 493-511.
- Smith, M. (1999). *Realizing the benefits from investment in ERP*. *Management-Accounting*, 77 (10), 34.

Stedman, C. (2000). *ERP problems put brakes on Volkswagen parts shipments*. *Computerworld*, January 03.

Strauss, A. & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*, Sage, Newbury Park, CA.

Tolbert, P.S. (1988). *Institutional effect on organizational structure*. In L.G. Zucker (education), *Institutional Patterns and Organizations: Culture and Environment*. Cambridge, MA: Ballinger Publishing Co.

Trice, H.M. & Beyer, J.M. (1984). *Studying organizational cultures through rites and ceremonials*. *Academy of Management Review*, 9 (4), 653~C671.

Turner, B. (1981). *Some practical aspects of qualitative data analysis: One way of organizing the cognitive processes with the generation of grounded theory*. *Quality and Quantity*, 15, 225~C247.

Walker, A. H. & Lorsch, J.W. (1996). *Organizational choice: Product versus function*, in J.M. Shafritz & J.S. Ott. (Eds.), *Classics of Organizational Theory* (pp. 220~C231). Wadsworth Publishing Company.

Walsham. G. & Han, C. K. (1993). *Information systems strategy formation and implementation: The case of a central government agency*. *Accounting, Management and Information Technology*, 3 (3), 191~C200.

Weick, K.E. (1995). *Sensemaking in Organizations*, Thousand Oaks, CA: Sage

Zmud, R. W., Anthony, W. P. & Stair, R. M. (1993). *The use of mental imagery to facilitate information identification in requirements analysis*. *Journal of Management Information Systems*, 9 (4), 175~C196.

Chapter 6: ERP Systems, Training Quality and Resultant Use Quality Perceptions

Nicole Mayer, Griffith University, QLD,
Australia

Training methods used during ERP package implementation remain largely unstudied in Information Systems literature. This chapter investigates the "product quality" of a training program developed at an Australian university implementing PeopleSoft, to develop a definition of training quality. By examining use quality characteristics and assessing user perceptions against training results, conclusions are drawn indicating that high quality training leads to positive user perceptions of an ERP system.

INTRODUCTION

Enterprise Resource Planning (ERP) systems, Information Systems (IS) which have been growing in both popularity and use since the early 1990's (Kumar and Hillegersberg, 2000) are generally considered quality systems by both their developers and the world at large. This quality is in the form of product quality, one of many available definitions. Much research into IS quality is concerned with this concept of product quality (Eriksson and Higgins, 1994) and this can be applied against the quality of training. However, the product-based view, which is also considered in much ERP literature, does not consider the multitude of user issues associated with ERP implementation and acceptance.

Use quality, strongly related to user perceptions of a system, remains largely unstudied in the context of ERP systems and it is the intention of this chapter to relate the product quality of ERP training back to user perceptions and therefore ERP implementation quality rather than the more traditional views. It is intended to prove that high quality training leads to positive user perceptions and therefore high use quality of ERP systems. Mahapatra and Lai (1998) acknowledge that for successful ERP implementation, training is of great importance therefore these results are applicable to any manager involved in such an endeavour. It should also be noted that this paper investigates the perception of ERP system quality rather than the quantifiable actuality.

DEFINITION OF TERMS

Enterprise Resource Planning systems can be described as "configurable information systems packages" which integrate information and processes across organisational functional areas (Kumar and Hillegersberg, 2000). While the motivations for ERP implementation are quite well studied, there is a significant lack of research in the area of outcomes when examining issues of user acceptance, user training, and more specifically, university environments and successes achieved (Sieber et al., 1999).

It is essential to define training, a term widely understood as a means of transferring knowledge from one party to another. This study will refer to training as a formal effort to transfer IS knowledge, required by users to perform essential tasks (adapted from Nelson and Cheney, 1987a). Many variables such as enduser ability have been cited as impacting training effectiveness, however this study will investigate training quality. Currently, no best practice ERP training approach exists although researchers such as Markus and Tanis (2000) and Brown and Vessey (1999) have proposed general implementation frameworks. This lack of training focus is possibly due to the lack of training research in terms of IS theory development and relation to organisational concepts (Kozlowski and Salas, 1997; Nelson and Cheney, 1987a).

Quality

Many definitions of quality exist and quality, especially when applied to IS, seems notoriously difficult to clarify. As stated earlier, this paper will discuss how the intrinsic "product quality" of ERP training can lead to good "use quality" of an ERP system. Product Quality can be defined as part of a "multifaceted concept" focussing on a precise and measurable variable (Garvin, 1984) whereas Use Quality concerns how well the system serves the user and fulfils their varied requirements (Eriksson and Torn, 1991).

Eriksson and Higgins (1994) give a user-based definition of quality as such: "The quality of a product depends upon how well it fits patterns of customer preferences." It is acknowledged that this interpretation of quality is the most difficult to measure and new means of assessment must be found (Swanson, 1997). The definition is most appropriate for this study, as user perceptions are under investigation rather than the quantifiable, product-based definitions adopted by many researchers.

METHODOLOGY AND PROJECT BACKGROUND

The topic was investigated based upon data collected for a research project in which the impacts of training and ERP interfaces upon user acceptance were investigated. The research site, PROJECT20001, involved implementation of selected "Financials" modules of the PeopleSoft ERP product at an Australian university. An external consulting company performed as an implementation partner, providing technical support and validated implementation methodologies.

PROJECT2000 adopted stringent training procedures as one of the primary means of achieving high levels of user acceptance. These procedures involved introductory sessions, focussed work shops and hands-on training. Other techniques adopted (such as advertising and removal of the old system) will not be investigated in this paper. At the time of investigation, the first released modules have been widely accepted by the majority of business system users and it is intended to demonstrate the strong link between the quality of the training and the high rate of user acceptance.

Data was collected for an Honours research dissertation and the data has been revisited for this paper (Mayer, 2000). The data was gathered by attending a variety of PROJECT2000 training sessions and then conducting follow-up structured interviews with the attendees. Post-training session survey data from the attendees was also analysed. The trainers themselves were formally interviewed to assess how the training product was developed and their personal input and history.

For the purposes of this chapter, definitions of IS quality were investigated and assessed with respect to the two areas under investigation: training and ERP "usefulness" (leading to acceptance). Appropriate models were adopted and modified where necessary to give a definition of training quality, and the actualities of PROJECT2000 were assessed against the models. Finally, links were drawn between training quality and use quality.

QUALITY MODELS

Product Quality

Garvin (1984) identifies eight dimensions of product quality which are useful to assess against a given product. While a training program can be considered a product, it is noted that certain dimensions are highly inappropriate and therefore unable to be assessed. Performance and reliability cannot be paralleled but this model is useful in developing a definition of training quality by assessing the remaining categories. In several cases, the definitions of the dimensions have been largely modified. The dimensions have also been ranked, the order below demonstrating what is considered the most to the least important to achieve training quality.

1. Conformance

This attribute considers how closely related this training product is to other products that exist on the market; those that trainees may have previously experienced. A high degree of program conformance may lead to higher levels of user acceptance due to familiarity with the environment (Nelson and Cheney, 1987b).

2. Aesthetics

This dimension relies on the overall appearance and "slickness" (smoothness) of a training product. How is it delivered? How professional are the Training Managers (TMs)? Are they well versed in their domain and training knowledge? Other questions can be more concerned with the physical side of things: Are TMs well dressed? Is the training environment clean? Is equipment new or clean and enticing to use? Are any provided materials well-set out and easy to read?

The above questions all have very subjective answers, however much like quality, most trainees will agree that good aesthetics are instantly recognisable (for further discussion of this topic, refer to Mayer (2000). The overall aesthetics of a product depends on various attributes, also incorporating some of the concepts included under the heading of "serviceability" such as competency and courtesy.

3. Perceived Quality

This dimension is closely related to aesthetics however deals less with specific attributes of the training product and more with an overall evaluation. This is typically based upon what the trainee knows about the history of the TMs and product: do they have an established reputation and can the trainee trust them to deliver what is promised? Reputation and affiliation ^a from where the training product has arisen ^a are of prime importance.

4. Features

Features include a training product "extras," that is, characteristics outside the product's basic purpose. These may include gifts for the trainees, lunches, anything designed to ensure trainees are more than pleased with the experience and the accessories it brings.

Table 1: Features of an ERP Training Product

Training Quality Dimension	Training Process Features	Quality Dimension Impact
1. Conformance	"Classroom" approach (Ralphs, 2000) Material delivery, hands-on Reliance on technology of minimal concern	Positive
2. Aesthetics	New equipment, professional trainers Shared TM, trainee nervousness ; rapport	Positive
3. Perceived Quality	Organisational staff as trainers ; high trust levels	Positive
4. Features	Training manuals, refreshments	Positive

5. Durability	Style retained for several sessions	No discernable impact
6. Serviceability	Helpdesk, manuals found non-effective Co-worker support most effective means	Negative

5. Durability

Durability is concerned with the "life" of a training product, that being how long it may be used without becoming outdated or inappropriate to the training situation. For example, a PeopleSoft training product developed for Release 1 will no longer be appropriate in ten years if the expectations of trainees have changed.

A training product cannot "fail" in the typical product sense, but it can be "repaired" in terms of updates to the style of teaching, delivery and circumstances. A highly durable training product results in time and cost savings for the company with ownership, therefore the desired durability of a training program must be assessed against its use life before it is fully developed.

6. Serviceability

Garvin (1987) defines serviceability as speed, competency and courtesy related to service repair. For training, a different approach is required and serviceability can be loosely related to the effectiveness of future training support. The above-mentioned attributes of speed, competency and courtesy with which posttraining session support is provided has greatest impact on user perceptions.

Training Quality Defined

The above analysis leads to the working definition of training quality, which is derived from product quality definitions and an analysis of the research data for PROJECT2000. A quality training product is ideally established by a reputable organisation, delivered by a trained team of professionals in a pleasing environment. It offers a balance of features while conforming to expected session perceptions and ideally, has an appropriate life and good follow-up procedures.

As mentioned earlier, this definition relies on very subjective attributes as it can be argued that a pleasing environment to one person is certainly not what the second trainee desires. The difficulty is in finding a balance of what is most pleasing and appropriate for all trainees in each dimension mentioned, and assessing these against differing user perceptions may give an overall picture of how the training quality has been perceived in a specific situation.

The SOLE Model

Through examination of several quality models, it was decided that the SOLE Software Quality Model ((Eriksson and Torn, 1991), (Eriksson and Higgins, 1994), (Lindroos, 1997)) would be of most use in assessing the components associated with ERP package quality and the associated training. Three quality factor classes, IS Business Quality, IS Use Quality and IS Work Quality form the basis of the model and are further split into analysable elements (Eriksson and Torn, 1997). However, it should be noted that this model is "theoretical and rather abstract".

The part of the SOLE model relevant to ERP systems implementation involves Use Quality, and this is directly associated with user perceptions of the system and how well the system serves the user (Lindroos, 1997) which matches the earlier identified user-based quality definition.

Use Quality

Use Quality in the SOLE model (Eriksson and Torn, 1991) is broken down into two requisite parts: requirement quality and interface quality, which can be further divided into ease-of-use and ease-of-learning. With an ERP system, both quality attributes are often neglected from an implementation point of view as an ERP already has both an interface and implied requirement fulfilment.

TRAINING PRODUCT QUALITY ANALYSIS

By using the dimensions modified from Garvin (1987) and applying the derived definition of training (product) quality, an assessment of a real-world training process may be made. PROJECT2000's training method incorporated a variety of tools and techniques to successfully distribute the necessary information to all trainees. This information primarily consisted of system usage techniques rather than methods of customisation. The following table indicates key impacts.

The above assessment demonstrates that a highly appropriate training product was developed for PROJECT2000. TMs and trainees interacted on an equal basis, allowing a flow of communication and understanding between the two groups based upon their similar goals and interests. The conformance and aesthetics dimensions were well fulfilled, definitively enhancing the perception of the training sessions and most trainees rated the sessions as "very good" (Mayer, 2000).

Following the training sessions, all survey respondents had a very high perception of ERP systems. They had been given appropriate system overviews and a working knowledge of how they would be expected to use the system. After system implementation, trainees still conceded that the ERP system was of good quality, and many acknowledged that their current complaints and frustrations would likely disappear with time and experience. Not all parts of the system were yet implemented at the time of analysis, and it is interesting to note that all employees interviewed had a high degree of faith in both the ERP and the development team that missing functionality would eventually be successfully implemented. This faith can be related to quality perceptions, of both the system itself and the delivery team, which included all TMs.

From this analysis, it can be seen that the majority of requirements were fulfilled therefore a high quality training package was developed for PROJECT2000. Links can be drawn between specific characteristics of training quality and use quality which is assessed below.

USE QUALITY ANALYSIS

Customisation of ERP systems is the traditional approach to fulfilling requirement and interface quality provisions. The ERP project studied took a serious approach to determining user requirements, however few customisations were actually performed. The following analysis demonstrates that based upon typical measures, users should have been left with a poor impression of the new system. This then leads into examination of the use quality perceptions which result.

Requirements

By their very nature, ERP systems discourage requirements modification (Soh et al., 2000). Customisations are typically limited to choices of which fields or screens to use, rather than modification of the internal processes and calculations and reports can be customised.

PROJECT2000 stated up front that the ERP implementation was to be used not only to deliver a new integrated system, but to "force" process change across the university (NABS, 1999). Therefore, to analyse how well the system serves the user (Eriksson and Torn, 1991), the best method of assessment is to examine the standard system.

PeopleSoft is designed to meet the "average" users' needs, a typical user being any person from anywhere within the world without consideration of cultural, governmental or business constraints. The system is based upon best-practice techniques however there is considerable contention as to whether these methods suit any real-world user (Davenport, 1998). The system is not designed to meet business changes and upgrading the ERP is often extremely expensive for any client who performed customisations. However, the essential attribute of security (Eriksson and Torn, 1991) is well met by the system (dependant upon initial user set-up).

Interfaces

PeopleSoft's developers promote the product as having an easy to learn and use interface, something readily agreed with by interviewed users. It is also acknowledged that the system is fast to use (dependant upon university network connections). However, PeopleSoft fails to fulfil the categories of adaptability to the user's style, and many complaints have been registered regarding scrolling features and the multitude of screens. Some provisions exist for user-interface customisation (the "Favorites" tool a notable example) but the dimension of flexibility remains largely unsatisfied. Users have also complained about the system-provided error messages, often cited as too ambiguous or technical to be of use.

Both of the above categories demonstrate a deficiency in the fulfilment of typical use quality attributes and based upon this assessment alone, it would be predicted that the system fails to include IS use quality. User perceptions of the system should lie in the negative dimension, especially as an ERP is not designed for a specific business environment. However, PROJECT2000 users have generally agreed that the system serves their needs quite well and acknowledge that current concerns are merely part of the "settling in" process. Users are generally satisfied with the interface and functionality provided, and are actively using the new system. A high level of use quality is presumed to have been achieved.

Swanson (1997) examines numerous quality dimensions and incorporates several of the above attributes as part of meeting and/or exceeding of customer expectations to give IS quality. Given the positive system perception, it is apparent that the customer expectations have been met, therefore analysts must look beyond the traditional fields associated with use quality and examine the impact of other influences including training.

TRAINING QUALITY TO USE QUALITY

It is useful to draw together the training quality and use quality dimensions and this is demonstrated in Figure 1. Individual characteristics may be correlated on a very generic level to demonstrate tenuous links between the categories. As with most studies in IS, the below links cannot be quantitatively proved, however it has already been demonstrated that there are significant impacts on use quality perceptions, the most likely being training.

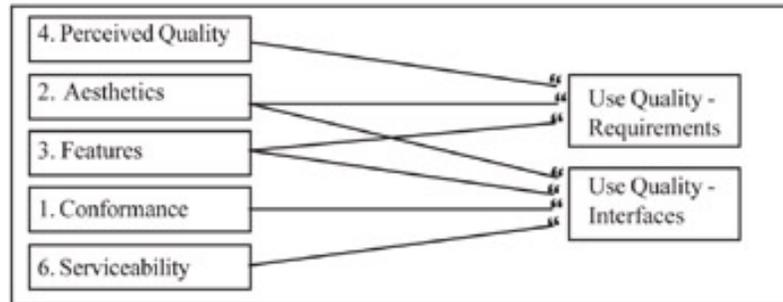


Figure 1: Linkage between training quality and use quality.

The analysis and explanation of these linkages has been proven in the PROJECT2000 situation. Note that the quality characteristic of durability has been omitted from Figure 1, as users are not concerned with the lifetime of a training product.

The dimension of aesthetics has perhaps the greatest impact on levels of use quality. The TMs, through their enthusiasm and professionalism, demonstrated their satisfaction with the interface and did not demonstrate any desire for change which the trainees might have noted had they been projecting their own desires. The high level of trust between the two groups could have resulted in positive impressions of system security and system speed. In-class computer faults which were later replicated in real-world environments maintained an impression of knowledge; the trainees were aware of the problems and knew how to deal with them.

Conformance relates to user comfort with the static interface. Due to the high level of comfort with the training environment, trainees were comfortable with the examples and situations presented during training, and therefore an up-front acceptance of the system interface is achieved.

Features of the training session also resulted in positive perceptions, primarily through the provided training notes. This manual again reinforced the idea of a static interface giving users no scope to demand change, and this includes disinclination of requirements and business changes.

The trust issue is again raised when considering perceived quality of the training product. Because trainees trusted the TMs, they implicitly trusted the business changes presented as something which had to happen for the good of the university. This is perhaps one of the key impacts of the quality training process.

Finally, while serviceability had a negative rating for PROJECT2000, its results can be seen in poor user impressions of error messages (relating to the interface category). If informed staff had been available via the helpdesk to explain PeopleSoft error messages, perceptions in both dimensions might be improved.

Therefore, it can be concluded that product quality influences use quality in at least one situation of ERP implementation. Further research and results are necessary to determine if this is the case for a variety of ERP projects, and comparisons with situations using alternative training forms such as intranets would be extremely useful (see Mahapatra and Lai, 1998). Assessment of the training quality definition developed is also necessary from a variety of perspectives outside of the ERP domain.

It is important to note that training quality is not the only contributor to high levels of user acceptance. A range of impacts occur from areas such as system support, advertising, personal skill, the ERP system itself and the business environment, each impact having various levels of influence. Regardless of the extent of the impact, each of these must be considered in addition to training when undertaking an ERP implementation.

Finally, it is useful to consider the impact of achieving good use quality. Salmela (1997) points out that IS quality, directly related to use quality, impacts business quality (loosely defined as the net value of an

IS). This matches the ethos behind ERP implementation: it is intended to gain benefits (typically financial) for the implementing company.

CONCLUSION

By adopting a user-based definition of quality, an analysis has been made of training products in general. Through definition of training quality, assessable on the six dimensions of conformance, aesthetics, features, perceived quality, durability and serviceability, it has been demonstrated that high quality training can lead to positive user perceptions of a new system. Evidence has been provided from one ERP implementation site, allowing qualitative links to be drawn between the differing dimensions of product quality and use quality.

Future studies are necessary to validate both the training quality definition and the linkage to use quality. It is hoped that this paper is viewed as a useful reference for investigations of either nature.

* The name of the organisation has been disguised to maintain confidentiality.

REFERENCES

- Brown, C. and Vessey, I. (1999). *ERP implementation approaches: Toward a contingency framework. Proceedings of the International Conference on Information Systems (ICIS)*.
- Davenport, T. (1998). *Putting the enterprise into the enterprise system. Harvard Business Review*, 76(4), 121-C132.
- Eriksson, I. and Higgins, L. F. (1994). *Perceptions of creativity and quality constructs: An empirical study of IS educators in Finland. Proceedings of the Twenty-Seventh Annual Hawaii International Conference on System Sciences*, 383-C391.
- Eriksson, I. and Torn, A. (1991). *A model for IS quality. Software Engineering Journal*, August, 152-C158.
- Eriksson, I. and Torn, A. (1997). *Introduction to IST special issue on information system quality. Information and Software Technology*, 39(12), 797-C799.
- Garvin, D. A. (1984). *What does "product quality" really mean? Sloan Management Review*, Fall: 25-C45.
- Garvin, D. A. (1987). *Competing on the eight dimensions of quality. Harvard Business Review*, November-December, 101-C109.
- Kozlowski, S. W. J. and Salas, E. (1997). *A multilevel organizational systems approach for the implementation and transfer of training. In Ford, J. K. (Ed.), Improving Training Effectiveness in Work Organizations*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Kumar, K. and Hillegersberg, J. v. (2000). *ERP experiences and evolution. Communications of the ACM*, 43(4), April, 23-C26.
- Lindroos, K. (1997). *Use quality and the World Wide Web. Information and Software Technology*, 39(12), 827-C836.
- Mahapatra, R. K. and Lai, V. S. (1998). *Intranet-based training facilitates ERP system implementation: A case study. Proceedings of 1998 Americas Conference Association for Information Systems*.
- Markus, M. L. and Tanis, C. (2000). *The enterprise systems experience: From adoption to success. In Zumund, R. (Ed.), Framing the Domains of IT Research: Glimpsing the Future Through the Past*. Cincinnati, OH: Pinnaflex Educational Resources, Inc.
- Mayer, N. (2000). *Enterprise Resource Planning Systems: A Comparison of Business and Academic User Acceptance Within a University Environment*. School of Computing and Information Technology. Brisbane, Griffith University.
- NABS. (1999). *Welcome to the New Age Business Systems (NABS) Project*. Brisbane, Griffith University.
- Nelson, R. R. and Cheney, P. H. (1987a). *Training end users: An exploratory study. MIS Quarterly*, 11(4), 547-C559.
- Nelson, R. R. and Cheney, P. H. (1987b). *Training today's user. Datamation*, May, 15, 121-C122.
- Ralphs, S. (2000). *IT education events leave much to be desired: Self-teach labs offer better opportunities to kick the tires. Computing Canada*, 26(9), 11.

Salmela, H. (1997). *From information systems quality to sustainable business quality. Information, Software and Technology*, 39(12), 819-825.

Sieber, T., Siau, K., Nah, F. and Sieber, M. (1999). *Implementing SAP R/3 at the University of Nebraska. Proceedings of the International Conference on Information Systems (ICIS)*, 19.

Soh, C., Kien, S. S. and Tay-Yap, J. (2000). *Cultural fits and misfits: Is ERP a universal solution? Communications of the ACM*, 43(4), April, 47-51.

Swanson, E. B. (1997). *Maintaining IS quality. Information and Software Technology*, 39(12), 845-850.

Chapter 7: Assessing Enterprise Resource Planning (ERP) Adoption in the Philippines

**Maria Divina Gracia Z. Roldan, University of the Philippines Cebu College,
The Philippines**

**Antonio R. Zamora, De La Salle University,
The Philippines**

**Frederick D. Amores, Third Wave Software Associates,
The Philippines**

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 non formal 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^a 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 is in South Portland, Maine, U.S.A., 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 Sta. 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 three 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 one to two 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 three to four 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 underwent 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 \$ 550,000.00 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, as we shall 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 is 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 that 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 sector. 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 Hanjaya 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 rewards 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 piece meal. 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 Hanjaya 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 need 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 (Ushashri, 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.

COMPARATIVE ANALYSIS OF CASES

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

	FAIRCHILD SEMICONDUCTOR	ISLACOM	CPPC	STERLING TOBACCO
ERP Experience Start -	1977	Finance - 1998 Materials Management - mid 1999	Financial Module (sometime 1994-1997)	2000
Software	Oracle - Financials People Soft - HR, Shipping	Oracle - Financials SAP servicing modules - MM	Oracle - Financials	Oracle-Financials
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	(People Soft) Shipping - users slow response (dbase not properly tuned)	Cost overrun	*	Lack of appreciation of ERP Sales data capture & transmission to head office
Considerations for Choosing Software	Criteria a) demo-actual 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

* data unavailable

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

Views of ERP	FAIRCHILD	ISLACOM	CPPC	STERLING TOBACCO
D. Views of ERP 1. Inimitability (resource hard to copy / replicate)	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.	*	Inimitable as it could be acquired at great expense.
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 - management	Area - materials management -User	Area/Important Module - concerning Mgmt. of people, Operations, Financial management, Logistics planning Least useful - Marketing Use depends on nature of business	Whole firm especially management and finance
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.	Cebuano can do the program.	Yes.	*

* unavailable / not answered by respondent

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

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 & 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 Figure 3.

ABOUT THE ORGANIZATION	FAIRCHILD	ISLACOM	CPPC	STERLING TOBACCO
A. VISION/MISSION	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.	Has a social responsibility to provide effective telecommunication service in its pursuit to contribute to national growth & global cooperation through social, economic & technological development.	To showcase Filipino excellence in the power generation industry, creating a brighter world for everyone.	To be no. 2 in the industry.
B. 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.

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

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 mindset that is open to change.

Apparently, the management level have 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 interviewed 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 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, [Figure 4](#) shows the factors that drive and restrain Philippine business enterprises from adopting ERP.

	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, Vendor Support Competent People User Education
PULL FACTORS	Cost Educating people Application to local environment	Cost Transition stage - Merger brings uncertainty	Transition stage Resource constraints	Cost Resistance to Change

Figure 4: Push and pull factors in ERP adoption

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.

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 ERP. What really spells the difference are leadership/ management support, funding resources, and organizational culture. The role of leadership/management is vital in effecting 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 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.

REFERENCES

Davenport, S., Hubbard, G. Lewis, G., Morkel, A., & Stockport, G. (1999). *Australian and New Zealand strategic management: concepts, context and cases*. Sydney: Prentice Hall.

Davis, S. (1984). *Managing corporate culture*. New York: Ballinger.

Deal, T. & Kennedy, A. (1980). *Corporate cultures: the rites and rituals of corporate life*. Massachusetts: Addison-Wesley.

Fairchild Semiconductors, [online] Available: <http://www.fairchildsemi.com/> (02/ 18/01).

Gonzales, R. (1987). *Corporate culture modification: a guide for managers*. Manila: National.

Isla Communications Co. Inc., [online] Available: <http://www.islacom.net/> (03/2/01).

Jocano, F. L. (1988). *Towards developing a Filipino corporate culture*. Quezon City: Punlad Research House.

Khalil, T. (2000). *Management of technology: the key to competitiveness and wealth creation*. Boston: McGraw Hill.

Ptak, C. & Schragenheim, E. (2000). *ERP: tools, techniques, and applications or integrating the supply chain*. Florida: CRC Press LLC.

Sadagopan, S. (1999). *The world of ERP*. In Sadagopan, S. (Ed.), *ERP: a managerial perspective*. New Delhi: Tata Mcgraw-Hill.

Ushasri, T. S. (1999). *ERP: bridging business and technology*. In Sadagopan, S. (Ed.) *ERP: a managerial perspective*. New Delhi: Tata McGraw-Hill.

Chapter 8: The Next Wave in ERP Implementation

Keng Siau, Yuhong Tian, University of Nebraska-Lincoln,
USA

Although the benefits of ERP are obvious, the risks and costs associated with it are very high. Some problems in implementing ERP system are documented, but the real challenge comes from the Internet and E-business. ERP is an enterprise wide system whose purpose is to achieve internal efficiency, while E-business cuts across different enterprises and extends the individual value chain into an Internet based, dynamic process aimed at maximizing external efficiency. To survive the E-business challenge, the arguably single, and also the best, solution for ERP systems is to integrate with E-business applications, which we call ERP II. By properly resolving the issues of integration via newly emerged technologies, and embracing the extended function of mobile-commerce, ERP II will continue to flourish in the next century.

BACKGROUND OF ERP

Enterprise Resource Planning (ERP) is a set of applications that provide automated support in traditional business processes such as inventory control, material requirements planning and order processing. The essence of ERP is "integrating the resource of the entire enterprise" from an information standpoint." (Jacobs et al. 2000) Integration means more than "linking", "combining", or simply "putting together". The duplication of information is eliminated, time is saved and operational efficiency is improved. Integration in an ERP system is not limited to information; it may also involve business re-organization.

The reader may wonder what the difference between a common central database and an ERP system is. Jacobs et al. (2000) answered the question in a very simple way. In a central database, information goes from different functional areas to the central database where they can be shared, while in an ERP system, functions are linked one to another and to the database (See Figure 1). This means that a complete ERP package cuts across different business functions such as Manufacturing, Finance, Accounting, Marketing, etc. The essences of ERP are information sharing (which is the same as a common central database) and process integration (the unique character of ERP systems). Only when based on these two ideas can ERP achieve real resource optimization and thus by extension, cost reduction and revenue enhancement.



Figure 1: The difference between ERP and common central database

PROBLEMS WITH CURRENT ERP SYSTEMS

While ERP benefits are somewhat obvious, reaping those benefits is not easy. Several high profile ERP project failures have made companies more prudent in making the decision to implement.

One obstacle is ERP's high cost; the cost of an ERP suite ranges from \$2 million to \$130 million (Norris et al. 2000). This is enough to prohibit many companies from entering the door. Nevertheless, this only accounts for a fraction of the total cost of implementing an ERP system. Inappropriately choosing an unbearably expensive ERP can lead to complete failure. Trying to be everything to everyone has made ERP systems such as SAP AG's R/3 notoriously complicated, and installing the software often forces users to change their internal processes.

Implementing a big ERP package will be about half technology issues, and half organizational and human issues. Documented factors that lead to failure are lack of top management commitment, lack of project marketing and end user training, poorly defined business processes, inexperienced project managers, rushed deadlines, many complex tasks, wrong team members, unmotivated teams, communication breakdowns, and political issues.

ERP II: FACING UP THE INTERNET AND E-BUSINESS CHALLENGE

After Y2K, a cold wind blew through the ERP software market. The Internet revolution and the surprising speed with which e-business began to change the way business was done caused many users to cool on rushing to implement traditional ERP systems, and profits of some of the software vendors seem frozen at year-ago levels. It appears that ERP will disappear under the deluge of E-commerce and Internet development.

The ERP market, however, still has life in it. This is attributed to the birth of a brand new ERP system¹ ERP II. By integrating legacy ERP systems with Ebusiness applications, both ERP vendors and companies that implemented ERP have found a way to face up to the challenge of the Internet.

The Internet has created new ways for suppliers, manufacturers, retailers, and customers to communicate and do business. However, this should not be interpreted as the obsolescence of ERP, or that the internal efficiencies achieved by ERP systems are no longer crucial. The internal efficiencies that can be achieved by ERP system can be used as a basis for efficient communications with customers and business partners in the Internet economy.

The e-commerce game is not as simple as once thought - establish a website, activate it and then continue to upgrade it. In short, the lack of an internal efficiency support system such as ERP is one of the reasons why many dot coms are currently in dilemma, and losing money at every transaction.

To achieve the goal of integration, ERP II vendors, consultants and implementing organizations must address the following problems:

- **Information Sharing.** ERP systems have traditionally focused on internal operations, such as human resources, financial, and manufacturing. Each application is generally accessed by a limited number of users. But the fast growth of E-commerce is placing demands upon corporations to make more of that information available to more internal users, as well as authorized outside customers and vendors.
- **Optimization Focus.** ERP forces optimization of business processes within the company, while E-business advocates optimization across different companies' value chains. From a total value chain perspective, optimizing only business processes within the company can be sub-optimal. There is a need to integrate across value chains using the Internet. For this to be viable, ERP vendors have to make significant internal changes to their packages.
- **Internet Substitute.** The Internet poses another enormous challenge. The old idea that a single ERP system can solve all of one's problems is decaying under the weight of the Internet. The functionality now provided by ERP vendors, such as payroll processing and transportation management, could gradually be usurped by scrappy Internet companies that will provide separate components that can be linked together on one interconnected network. With this, the advantage of an integrated ERP system will be partially eclipsed.
- **Technology Obstacle.** Many of the existing ERPs cannot support interactive e-commerce because of a variety of incompatible hardware, software, and data descriptions. Since they were intended to link application systems inside enterprise boundaries, many existing ERP infrastructures were designed to support only certain EDI exchange and data translations. Such enterprise applications cannot be used as a foundation for an e-commerce infrastructure, which must link web-based e-commerce and traditional processing systems by open standards.

THE SOLUTION

The Internet and E-business have changed organizational structures from self-sufficiency to interdependency, and so have enterprise information systems. To deal with the challenge of the Internet and E-business, an individual ERP system must be able to "talk" to other ERP systems and other kinds of information systems as well as individual customers. Integrating ERP systems with E-business systems is the next step in ERP evolution.

- *General architecture*

The idea is to place the ERP applications at the heart of the company's systems and to integrate legacy applications, other critical business systems, and external applications (business partners' and customers' systems). In this scenario, the ERP system becomes a business-services framework, a central information repository, and a data-distribution facility to gain both internal and external efficiency and effectiveness (see [Figure 2](#)).

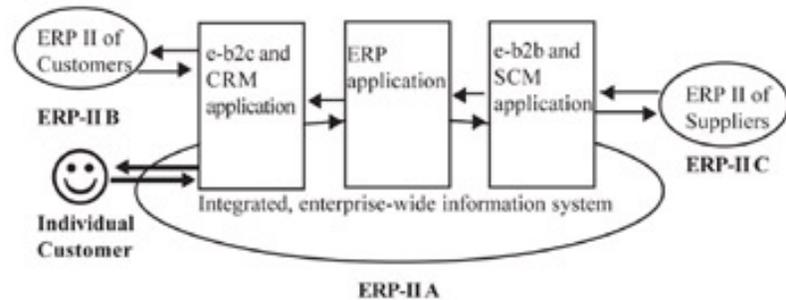


Figure 2: ERP II system architecture

When viewed from within enterprises, the idea is to integrate one ERP system with other ERP systems, and thus create an extended value chain (see [Figure 3](#)).

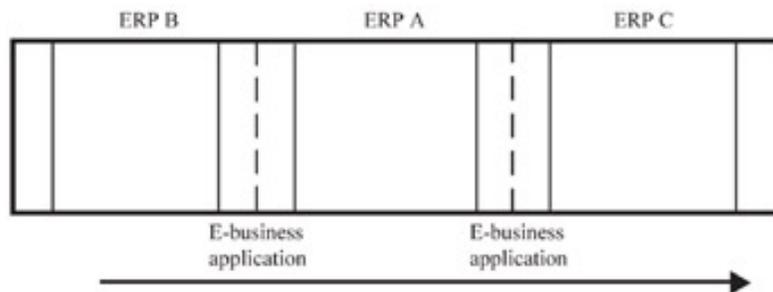


Figure 3: Integrated ERP value chain

In this scenario, the joint between ERP systems is dynamic, which means it dynamically provides the integration of two ERP systems via the Internet. A company can create an extended value chain that best suits its needs in real time by choosing or changing the "partner ERP system" to integrate. In all, the new ERP systems extend internal resource optimization to external resource optimization, and therein lies the real beauty of "integration."

- *Extended function: Mobile-commerce*

Currently an exponentially growing technology, wireless and mobile networking, has brought about a whole new way for companies to do business; mobile commerce. Mobile commerce has extended the function of e-commerce to previously unimagined dimensions. Wireless Application Protocol (WAP) hides the application differences from mobile users through proxy gateways. In the future, e-business applications will be accessible everywhere by various devices such as PCs, TVs, PDAs and cellular phones etc (Varshney et al., 2000). Wireless technologies will find a broad range of applications in ERP systems.

- *Technical Feasibility*

Technical compatibility presents a great challenge in integration. Systems from different vendors or

on different platforms may not work with each other very well, or at all. When it comes to integration of ERP and E-business, which typically involves communication across a variety of hardware and software systems, compatibility poses a threat to implementation. New technologies such as XML, SOAP, and standard component technologies such as COBRA, JavaBeans, and DCOM have been developed to cope with these difficulties. When properly applied, they can elicit a smooth interoperability between different platforms.

These middle-ware technologies provide the bridge both between ERP systems and other applications, and between ERP systems across enterprises through the Internet (see Figure 4).

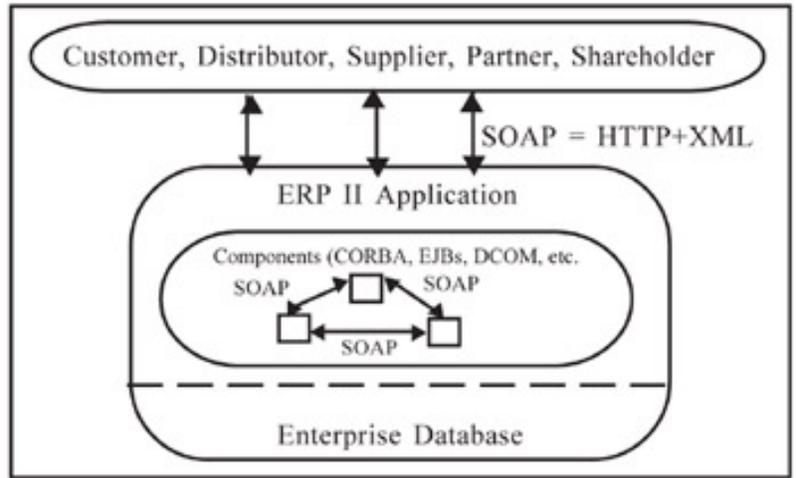


Figure 4: The ERP II solution from technology perspective

- ASP¹Another Choice

When speaking of ERP implementation today, we must consider the fast emerging ASP (application service provider) market. Traditional client/server ERP software has become extremely burdensome, as discussed earlier. For example, it is too expensive, it is too hard to implement, and it is too complex. This has given birth to the rise of the ASP market. Oracle, the big ERP vendor, has forged ahead in the ASP market. It provides a service allowing companies to rent expensive business applications on a hosted, per-user/per-month basis. Of course, outsourcing isn't a new trend. What is new, however, is the way in which the new servicebased ERP solutions are delivered over the Web. Web-based services are more about communication and multiple company workflows than the data-intensive functions of traditional ERP software. It is highly possible that ASP will drive the market in the future. Data-quest predicts ASP revenues will soar to \$22.7 billion by 2003. An entirely new option is there for IT managers who are considering which ERP system to choose.

CONCLUSIONS

MRP systems arose from the need to link manufacturing and production functions, and the development of ERP brought business systems to the next level; integration of those processes with the rest of the enterprise. Now, after companies have integrated their internal processes, by taking advantage of the Internet, they look to the next vista, linking to customers and business partners and external processes through wired and wireless networks. Regardless of what incarnations ERP may have gone through, the essence of enterprise software remains focused on maximizing efficiency (internal and external) and providing competitive advantage. This is the case for both MRP and ERP, as well as for the newly emerged Ebusiness suite, ERP II.

REFERENCES

- Apicella, M. (2000). *The hand that moves your business*, <http://www.infoworld.com/articles/tc/xml/00/06/26/000626tcopener.xml>, InfoWorld Test Center, June 23.
- Bosak, J. and Bray, T. (1999). *XML and the Second-Generation Web*, <http://www.sciam.com/1999/0599issue/0599bosak.html>.
- Box, D. (2001). *SOAP Increases Interoperability Across Platforms and Languages*, <http://www.msdn.microsoft.com/msdnmag/issues/0300/soap/soap.asp>.
- Briody, D. (2000). *Will ASPs Drive the Market?* June 23, http://www.infoworld.com/articles/hn/xml/00/06/26/000626hnasp_cto.xml. j°Can ERP Vendors Ride Net Wave?j± (1999). IT Professional, November-December, 7.
- Farmer, M. A. and Girard, K. (2000). (Staff Writers, CNET News.com). *Is the Enterprise Resource Planning Market Dead?* <http://news.cnet.com/news/0-1007-200-1512734.html>, January 4.
- Ferranti, M. (2000). *ERP and the Net: Evolve or Die*, <http://www.news.cnet.com/>, March 24.
- Haney, C. (2000). *Portal Platform is Complete*, <http://www.infoworld.com/articles/hn/xml/00/06/26/000626hniona.xml>.
- Hunt, J. (1998). *Essential Java Beans Fast*. London: Springer-Verlag.
- Jacobs, F. R. and Whybark, D. C. (2000). *Why ERP? A Primer on SAP Implementation*. Irwin McGraw-Hill.
- Krasner, H. (2000). *Ensuring e-business success by learning from ERP failures*. IT Professional, January-February, 22.
- Norris, G., Hurley, J. R., Hartley, K. M., Dunleavy, J. R. and Balls, J. D. (2000). *E-Business and ERP-Transforming the Enterprise*. Englewood Cliffs, NJ: John Wiley and Sons.
- Ross, J. W. (1999). *Surprising fact about implementing ERP*. IT Professional, July-August, 65.
- Scott, J. E. and Kaindl, L. (2000). *Enhancing functionality in an enterprise software package*. Information & Management, 37(3), 111.
- Varshney, U., Vetter, R. J. and Kalakota, R. (2000). *Mobile commerce: A new frontier*. IEEE Computer, October, 32°C38.
- Yurong, Y. and Houcun, H. (2000). *Data warehousing and the Internet's impact on ERP*. IT Professional, March-April, 37.

Chapter 9: The Impact of Enterprise Resource Planning Systems on Organizational Effectiveness;^aAn Artifact Evaluation

Jonas Hedman, Lund University,
Sweden
Andreas Borell, Tetra Pak Information Management,
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.

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 explicit conclusion from the IS benefit research (e.g. DeLone & McLean, 1992; Seddon et al., 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 et al., 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. 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 system 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 "i- 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 a 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 Fig. 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 system 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 j@technicalj interpretation of evaluation" (*Ibid.* 402) "C 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 et al. (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" (*Ibid.* 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, inter-organizational 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 "i- 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" (*Ibid.* 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 et al. (2000) proposed a "supra-framework labelled Organizational Economics". They propose that their model "i- can apply to all sorts of projects and organizational forms" (*Ibid.* 13) and suggest that IT investments can be considered as part of a chain of events: a senior management decision (i@IT Governancej) 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" (*Ibid.* 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 divided 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 and 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 et al., 1996), management research (Hart & Quinn, 1993), and IS research (Sääksjärvi & Talvinen, 1999) 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 were 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 of 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, teambuilding, 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 reason by which growth may be gained. Important issues are the acquisition of scarce resources, the support of interaction with the external environment, the identification of major trends, the development of business intelligence, the creation mental models, facilitation of changes, dedication to research and development, the identification of problems, influence the environment, and the maintain ace 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 workflow, 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 Fig. 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.

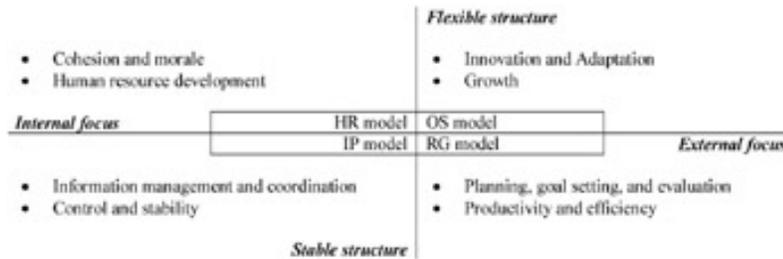


Figure 2: Competing values model (Quinn & Rohrbaugh, 1981; 1983; Rohrbaugh, 1981)

Since Quinn and Rohrbaugh's initial studies, the use of CVM has evolved to become a general framework for organizational and management research. Hart and Quinn (1993) used it to study executive leadership and assess overall organizational effectiveness; 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 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"CSAP 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, 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 "C 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, realtime 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 workflows (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 & 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, data base administration tools, e-mail, appointment calendar, functionality for room reservations, ordering food, a software development workbench, telephone integration, workflow 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 et al., 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 "C internal vs. external and stable vs. flexible. The third step was to classify each ERP systems 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, 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, the number of users of each function in an organization - its likely to assume that some functionality will have several users, e.g. a firm will have several sales persons.

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 Fig. 3.

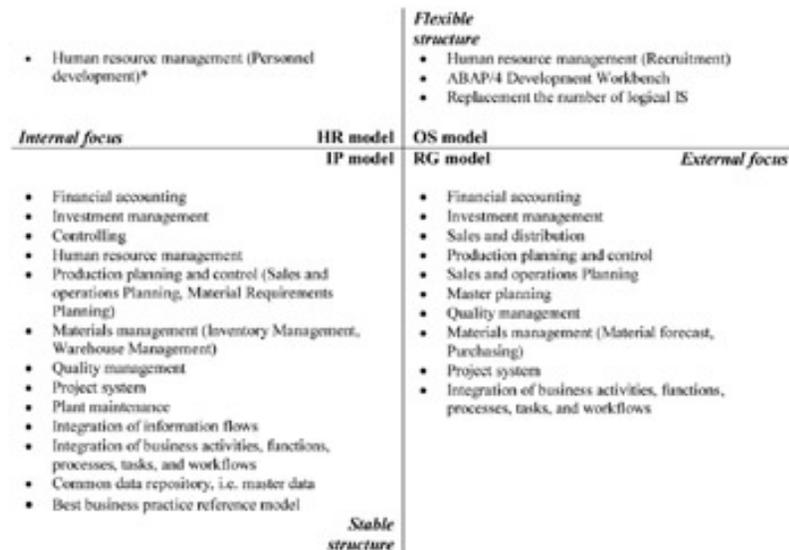


Figure 3: Mapping of ERP system capabilities into CVM. *Brackets indicate functions within functionality

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 system 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 in 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 organizations 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 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 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 state 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 model - related effectiveness measures, 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 managers.*

A question that arose regarding SAP R/3 "C 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 multi-dimensional 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 compatibility is provided by BAPIs (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 IP model and RG model and the shortcomings are related to HR model and OS model.

In a real-case situation our method must be complemented with both formal and in-formal 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 measurers.

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.

ACKNOWLEDGEMENT

We would like to thank the reviewers for their constructive suggestions and Kevin Fiffun. We also would like to thank Agneta Olerup and Sven Carlsson for their comments on earlier versions of this chapter.

REFERENCES

- Andersson, R. & Nilsson, A.G. (1996). "The Standard Application Package Market - An Industry in Transition?", In M. Lundeberg & B. Sundgren (Eds.), *Advancing Your Business: People and Information Systems in Concert*, EFI, Stockholm School of Economics, Stockholm.
- Bancroft, N.H., Seip, H. & Sprengel, A. (1998). *Implementing SAP R/3: How to Introduce a Large System into a Large Organization*, Manning, Greenwich, CT.
- Bedeian, A.G. (1987). "Organization Theory: Current Controversies, Issues, and Directions," In C.L. Cooper & I.T. Robertson (Eds.), *International Review of Industrial Organizational Psychology 1987* (pp. 1-23), John Wiley, Chichester.
- Borell, C.A., & Hedman, J. (2000). "CVA Based Framework for ERP Requirements Specification," *In the Proceedings of the 23rd Information Systems Research Seminar in Scandinavia*, Uddevalla, Sweden.
- Boudreau, M-C. & Robey, R. (1999). "Organizational Transition to Enterprise Resource Planning Systems: Theoretical Choices for Process Research," *In the 20th International Conference on Information Systems*.
- Buenger, V., Daft, R.L., Conlon, E.J., & Austin, J. (1996). "Competing Values in Organizations: Contextual Influences and Structural Consequences," *Organization Science*, 7, (5), 557-576.
- Caldwell, B. & Stein, T. (1998). "Beyond ERP-New IT Agenda - A Second Wave of ERP Activity Promises to Increase Efficiency and Transform Ways of Doing Business," *Information Week*, November 30.
- Cameron, K.S. (1981). "Domains of Organizational Effectiveness," *Academy of Management Journal*, 24, 25-47.
- Cameron, K.S., & Quinn, R.E. (1999). *Diagnosing and Changing Organizational Culture*, Addison-Wesley, Reading, MA.
- Cameron, K.S., & Whetten, D.A. (Eds.) (1983). *Organizational Effectiveness: A Comparison of Multiple Models*, Academic Press, San Diego, CA.
- Campbell, J.P. (1977). "On the Nature of Organizational Effectiveness," In P.S. Goodman & J.M. Pennings (Eds.), *New Perspectives on Organizational Effectiveness* (pp. 13-55), Jossey Bass, San Francisco, CA.
- Carlsson, S.A., & Widmeyer, G.R. (1994). "Conceptualization of Executive Support Systems: A Competing Values Approach," *Journal of Decision Systems*, 3, (4), 339-358.
- Cooke, D.P. & Peterson, W.J. (1998). *SAP Implementation: Strategies and Results*, The Conference Board.
- Cunningham, J.B. (1978). "A Systems Resource Approach for Evaluating Organizational Effectiveness," *Human Relations*, 31, 631-656.
- Davenport, T.H. Farbey, B., (1995, October 15). *SAP: Big Change Comes in Big Packages* [www document]. URL http://www.cio.com/archive/101595_davenport.html
- Davenport, T.H. (1998). "Putting the Enterprise into the Enterprise System," *Harvard Business Review*, 76, (4), 121-131.
- Davenport, T.H. (2000). *Mission Critical: Realizing the Promise of Enterprise Systems*, Harvard Business School Press, Boston, MA.

- DeLone, W.H., & McLean, E.R. (1992). "Information Systems Success: The Quest for the Dependent Variable," *Information Systems Research*, 3, (1), 60-C95.
- Deutsch, C.H. (1998). "Software That Can Make a Grown Company Cry," *The New York Times*, November, 8.
- Farbey, B., Land, F.F., & Targett, D. (1995). "A Taxonomy of Information Systems Applications: The Benefits' of Evaluation Ladder," *European Journal of Information Systems*, 4, (1), 41-C50.
- Galbraith, J.P. (1973). *Designing Complex Organization*. Reading, MA: Addison-Wesley.
- Glass, R.L. (1998). "Enterprise Resource Planning: Breakthrough and/or Term Problem?," *Data Base* 29(2), 14-C15.
- Hall, R.H. (1980). "Effectiveness Theory and Organizational Effectiveness," *Journal of Applied Behavioral Science*, 16, 536-C545.
- Hart, S.L., & Quinn, R.E. (1993). "Roles Executives Play: CEOs, Behavioral Complexity, and Firm Performance," *Human Relations*, 46, (5), 543-C574.
- Hirschheim, R., & Smithson, S. (1999). "Evaluation of Information Systems: A critical Assessment," In L. Willcocks & S. Lester (Eds.), *Beyond the IT Productivity Paradox* (pp. 381-C409). Chichester: Wiley.
- Jackson, M. (1995). *Software Requirements & Specifications: A lexicon of Practice: Principles and Prejudices*, Harlow, England: Addison-Wesley.
- Järvinen, P.H. (1999). *On Research Methods*, University of Tampere, Tampere, Finland.
- Järvinen, P.H. (2000). "Research Questions Guiding Selection of an Appropriate Research Method," In the *Proceedings of the 8th European Conference on Information Systems*, Vienna, pp. 124-C131.
- Joseph, T. & Swanson, E.B. (1998). "The Package Alternative in Systems Replacement: Evidence for Innovation Convergence," In T.J. Larsen & E. McGuire (Eds.), *Information Systems Innovation and Diffusion: Issues and Directions* (pp. 375-C389). Hershey, PA: IDEA-Group.
- Keller, G., & Teufel, T. (1998). *SAP R/3 Process-Oriented implementation: Iterative Process Prototyping* (A. Weinland, trans.), Addison-Wesley, Harlow.
- Kotter J.P. (1978). *Organizational Dynamics: Diagnosis and Intervention*, Addison-Wesley Reading, MA.
- Kumar, K., & Van Hillegersberg, J. (2000). "ERP Experiences and Evolution," *Communication of the ACM*, 43, (4), 23-C26.
- Lee, A.S (2000). *Editor's comments: The social and political context of doing relevant research*, *MIS Quarterly*, (24:3), v-Cvii.
- March, S.T., & Smith, G.F. (1995). "Design and Natural Science Research on Information Technology," *Decision Support Systems*, (15), 251-C266.
- Markus, M.L., & Tanis, C. (2000). "The Enterprise System Experience "C From Adoption to Success," In R. Zmud. & M.F. Price (Eds.), *Framing the Domains of IT Management: Projecting the Future Through the past* (pp. 173-C207). Cincinnati, OH: PinnaFlex.
- McKeen, J.D. & Parent, M. (1999). "An Integrative Research Approach to Assess the Business Value of Information Technology," In M.A. Mahmood & Szewczak, E.J. (Eds.), *Measuring Information Technology Payoff: Contemporary Approaches* (pp. 5-C23). Hershey, PA: IDEA-

Group.

Meyer, M.W. (1985). *Limits to Bureaucratic Growth*. Gruyter, Berlin.

Olerup, A. (1982). *A Contextual Framework for Computerized Information Systems*, Erhversøkonomisk Förlag, Copenhagen, Denmark.

Ostroff, C., & Schmitt, N. (1993). "Configurations of Organizational Effectiveness and Efficiency," *Academy of Management Journal*, 36, 1345-1361.

Quinn, R.E. (1989). *Beyond Rational Management: Mastering the Paradoxes and Competing Demands of High Performance*, Jossey-Bass, San Francisco, CA.

Quinn, R.E., & Cameron, K.S. (1983). "Organizational Life Cycles and Shifting Criteria and Effectiveness," *Management Science*, 9, (1), 33-51.

Quinn, R.E., & Cameron, K.S. (Eds.). (1988). *Paradox and Transformation: Toward a Theory of Change in Organization and Management*, Ballinger, Cambridge.

Quinn, R.E., & Hall, R.H. (1983). "Environments, Organizations, and Policymakers: Toward an Integrative Framework," In R.H Hall & R.E. Quinn (Eds.), *Organization Theory and Public Policy*, Sage Publications, Beverly Hills, CA.

Quinn, R.E., & Rohrbaugh, J. (1981). "A Competing Values Approach to Organizational Effectiveness," *Public Productivity Review*, 2, 122-140.

Quinn, R.E., & Rohrbaugh, J. (1983). "A Spatial Model of Effectiveness Criteria: Towards a Competing Values Approach to Organizational Analysis," *Management Science*, 29, (3), 363-377.

Robey, D., & Boudreau, M-L. (1999). "Accounting for the Contradictory Organizational Consequences of Information Technology: Theoretical Directions and Methodological Implications," *Information Systems Research*, 10, (2), 167-185.

Rohrbaugh, J. (1981). "Operationalizing the Competing Values Approach," *Public Productivity Review*, 5, (2), 141-159.

Rolland, C., & N. Prakash (2000). "Bridging the Gap Between Organizational Needs and ERP Functionality," *Requirements Engineering*, 5, 180-193.

Sääksjärvi, M. M. T., & Talvinen, J M (1996). "Evaluation of Organizational Effectiveness of Marketing Information Systems; the Critical Role of Respondents," In the *Proceedings of the 4th European Conference on Information Systems* (pp. 435-450), Lisbon, Portugal.

SAP (1997). *It's More than Software. It's a Strategic solution*. SAP AG, Walldorf, Germany.

Scheer, A. W. (1998). *ARIS - Business Process Frameworks* (2nd ed.). Berlin: Springer.

Scott, W. Richard (1992). *Organizations: Rational, Natural, and Open Systems* (3rd ed.). Prentice Hall, Engelwood Cliffs, NJ.

Seddon, P.B., Staples, S., Patnayakuni, & Bowtell, M. (1999). "Dimensions of Information Systems Success," *Communications of the Association for Information Systems*, 2, art 20. Retrieved January 15, 2001, from the World Wide Web: <http://cais.isworld.org/contents.asp>

Shang, S., & P.B. Seddon (2000). "A Comprehensive Framework for Classifying the Benefits of ERP Systems," In the *Proceedings of the 6th Americas Conference on Information Systems* (pp. 1005-1014). Long Beach, CA.

Shanks, G., Seddon, P., and Willcocks, L., (Eds.) (2001), *Enterprise Systems: ERP, Implementation and Effectiveness*, forthcoming, Oxford University Press, Oxford.

Tusi, A.S. (1990). "A Multiple-Constituency Model of Effectiveness: An Empirical Examination at the Human Resource Subunit Level," *Administrative Science Quarterly*, 35, 458-483.

Van Der Zee, J.T.M., & De Jong, B. (1999). "Alignment Is Not Enough: Integrating Business and Information Technology," *Journal of Management Information Systems*, 16, (2), 137-158.

Chapter 10: Transnational ERP Systems;^aThree Case Studies in Brazilian Subsidiaries of Multinational Enterprises

Cesar Alexandre de Souza, Ronaldo Zwicker, University of São Paulo (FEA-USP), Brazil

The development of global information systems infrastructure of enterprises offers many challenges, like the need to balance local and global systems requirements. The use of ERP systems (*Enterprise Resource Planning*) arises as a possible alternative for this development. This chapter aims to identify aspects involved in the use of ERP systems as transnational information systems, through the analysis of three implementation cases of ERP systems at Brazilian subsidiaries of multinational enterprises.

INTRODUCTION

According to Stephens (1999), one of the main business trends of the nineties was the strengthening of the multinational companies' global action, which, besides the mere export of finished products also began to distribute and diversify activities in their foreign subsidiaries. Such enterprises aim at profit through the carrying out of their activities in places where their competitive advantages can be put to a better use. Among the major challenges faced by these enterprises are integration and coordination of these geographically scattered activities to produce a continued flow of materials, products and information and enhance catering to each market.

One alternative for the implementation of information systems that meet the requirements of coordinating activities that cross national borders is the use of ERP systems, as they include various requisites intrinsic to global systems: they are offered in various languages, they allow the use of different currencies, their suppliers have support centers in different Countries of the world and they enable (and, many times, demand) the standardization of procedures and information throughout the entire organization. However, the implementation of an IT architecture at global scale encompasses managerial challenges that are greater than those of ERP systems shared by different divisions of an enterprise within a single Country.

This chapter aims to identify key aspects involved in the use of ERP systems in global enterprises for the purpose of meeting the requirements of transnational information systems. To meet this objective, three case studies in multinational enterprises with subsidiaries in Brazil were performed. The companies surveyed had, at the time of the survey, projects underway for the implementation of ERP systems at world level. In all of the cases the companies were already using ERP systems on a local level, in Brazil and in subsidiaries located in other countries.

TRANSNATIONAL ERP SYSTEMS

According to King and Sethi (1999), transnational information systems are IT based information systems that multinational enterprises employ for the coordination of activities that cross national borders. The major challenge in the development of global applications is the establishment of a correct balance between the global and the local requisites of the information systems. In general, this balance requires high levels of participation and commitment of the local users to the project.

In view of these challenges, ERP systems present some interesting possibilities to the setting up of transnational systems. First, ERP systems may contribute to standardize the enterprise's worldwide information technology platforms, making it more consistent. Second, ERP systems have a world reach as they include characteristics that facilitate their use in different countries, like the possibility of using several languages and currencies, and international support. And third, ERP suppliers seek to expand the availability in more Countries, by providing the software with the functionality needed to meet local requirements.

For Holland and Light (1999), international projects for the implementation of ERP systems are much more complex due to the need for multiple implementations through multiple project teams operating in parallel in multiple regions. According to Roche (1998), one of the difficulties in the implementation of global ERP systems is the fact that the local autonomy of IT departments may deter cooperation. This cooperation may not be easily achieved in business areas that do not wish to loose even the smallest parcel of their autonomy. Table 1 summarizes these and other aspects identified in the literature on global ERP systems.

Table 1: Benefits and problems of global ERP Systems

Benefits/Advantages	Problems/Difficulties
<ul style="list-style-type: none"> ● Possibility to obtain consolidated results, from all divisions of the enterprise, in all sites of the world, in a precise and on-line manner ● Possibility of better coordination of the activities of the enterprise's value chain carried out in different countries ● Possibility of offering a standardized global service to global clients ● Lowering of global IT costs ● Standardizing of the business practices at world level ● Availability in various countries with the possible use of various languages and currencies ● Allows IT platforms standardization around the world ● Shorter implementation time than that of a transnational system developed in-house 	<ul style="list-style-type: none"> ● Difficulty to create a standard model of the system for the different countries in which it operates ● Complexity of the implementation project, in view of its extent and number of teams working in parallel ● Various differences (characteristics of the different legacy systems, number of plants, geographical extension, number of divisions) may force the usage of different implementation strategies in each country ● Difficulty to accommodate differences in business concepts and practices in the same system ● Difficulties in language, calendar and time zones ● Differences in the quality and cost of telecommunications between the various countries ● Difficulties to adjust the "best-practices" models developed in European and North-

This paper presents the results of an exploratory research conducted with the objective to identify and deepen the understanding of key aspects regarding the utilization of ERP systems in enterprises' global operations. Three cases of large enterprises, that have already set up their ERP systems at local level and currently are expanding their systems throughout the corporation, were analyzed. The CIO's, which were the person in charge of the contacts with headquarters regarding the ERP projects, were interviewed in each enterprise. Interviews were done in May/2000.

The approach of case study is justified, as according to Yin (1989) case studies are useful in the research intended to contextualize and deepen the study of a theme. Results of the interviews and review of the material collected in each of the enterprises were used for the setting up of reports on each case. The reports were reviewed by the companies and used for the carrying out of this work. They are summarized below (names are fictitious).

THE THREE CASES

The Chemicals Case

Chemicals is an European group of chemical enterprises that markets its products in more than 100 countries, with plants in more than 20 countries and invoicing about US\$ 6.0 billion per year. The group has a decentralized IT management and each subsidiary seeks information technology solutions best suited for its budgets and operations. Although acting independently, the companies of the group are choosing the R/3 SAP system because they understand it has a tradition in the chemical area, especially in Europe, and because various subsidiaries of the company had already chosen it.

Recently, the group began to direct its efforts towards the creation of a standard configuration that would allow the integration of the various implementations of the R/3. As the implementation of R/3 took place independently in the various subsidiaries of the Chemicals Corporation, it was noticed that configuration differences rendered the different installations of the system incompatible. This is a recent initiative and the outcome of a study group on the subject, set up at headquarters. This working team is also undertaking a job of "convincing" all subsidiaries to use the R/3 system.

The group has two main reasons to look for a similar configuration: the perspective of on-line consolidation of data and centralization of servers. The possibility of consolidation of financial results, as well as on-line access to information on the operations worldwide is of interest to the enterprise, because the management of the group is centralized. Currently, information from different subsidiaries is consolidated in another software that receives data from the local systems by transfer of text files. Regarding centralization of servers, the enterprises perceived that the principal advantage is that operation costs are reduced, as the cost of keeping the different R/3 environments separate is considered high. The sharing of operation and maintenance services can apparently reduce the group's global IT costs.

The enterprise considers that the R/3 system has a design tending towards centralization. The consolidation of data from the various locations, when the system is carried out in a decentralized way, is a complex and expensive task due to the costs of operation, the technical complexity and the difficult administration of the system. Another advantage for the creation of an R/3 world model of Chemicals is the lowering of costs and time of implementation of this system in new acquisitions or enterprises that didn't set it up yet.

The dynamics of the enterprises' business processes in all the Countries is one of the difficulties expected by the group responsible for systems consolidation, as it requires constant local R/3 adjustments. Due to the ongoing changes it may be difficult to reach a point where all the subsidiaries have the same configuration, and so it is expected that the achievement of a standard configuration may only take place in the long term. One of the Brazilian subsidiaries took the initiative of adjusting to global standards, using the headquarters' concepts of business divisions and coding of products and materials, making use of an opportunity brought forth by the migration to a new manufacturer's version and already foreseeing future integration with headquarters' R/3.

The Bubbles Case

Bubbles is an American enterprise, manufacturer of flexible plastic packaging with plants in more than 40 countries, yearly invoicing about US\$ 3.0 billion. In Latin America (LA) the enterprise acts in 10 countries billing some US\$ 250 million per year. In 1997 the enterprise, that had already implemented the R/3 in two of its main USA divisions, called a meeting of a group of 60 representatives of the subsidiaries of the different countries for definition of a world strategy for its information systems. This group defined as world standard the use of R/3, with the long-term objective of implementing the system worldwide. Also a center of global excellence was set up to accumulate the best knowledge and experience in forthcoming implementations of the package.

In the LA subsidiaries the previous system comprised a standard package as directed by the headquarters for the region. This package did not reach the same integration level as the R/3 and was not customized for the year 2000 bug. The package had been distributed to the different localities that operated it and did the maintenance in a decentralized form. The LA system had to be replaced, mainly because of the year 2000 issue, and the option chosen for the region was the R/3, which was in accordance with headquarters recommendations. The system was implemented in Brazil, Argentina and Mexico, and a multinational project team was formed seated in São Paulo, Brazil, comprising users, IT personnel and consultants from the three countries involved in the implementation, besides members of the global excellence center.

The objective of the project was to achieve 80% configuration similarity of R/3 in the three countries, attempting to build a configuration for the region that could afterwards be implemented in the remaining LA countries. To reach this objective a rule was set forth so that the supposed differences among the countries would be closely checked. To be incorporated to the system, any regional difference had to be justified based upon: local legislation, business practices dictated by local competition or unfeasibility of changes in local processes in order to get adherent with the standard system. The LA project tried to follow the global standards defined by the enterprise's R/3 center of excellence, and justifications were also required if deviations from such standard were necessary. Even without a clearly defined focus for a global project, the team was aware of the integration requirements in the near future.

Part of the difficulties faced by the project's team resulted from the need to use different R/3 versions in the three LA countries initially involved. This happened due to differences in localization (adjustments to the local legislation made by the supplier of the product) in each of the versions. A number of other difficulties resulted from communication problems among the members of the team, impaired by language and culture differences. This required a greater managerial effort than first foreseen, as the solution of problems, including misunderstandings, needed considerable time. The LA implementation project took 20 months, against an initial forecast of 18 months, and some 6 million dollars were spent, considered a high price for the enterprise investments in the region. Part of the investment was justified by the need to meet the standards set by the enterprise. About 20% of the amount was related to reallocation and travel expenses and lodging for the project's team. After the initial project, consulting support was no longer required to implement the R/3 system in Uruguay, Chile and Venezuela.

Once implementation in LA was concluded, a unified IT team was formed for the region. This team, comprising 31 employees distributed in the three main countries, assists in a uniform manner the 700 users in all LA countries. Communication among the team is a fundamental issue for the success of the model and is done by means of dedicated voice channels. The LA R/3 system is located in one single server at the enterprise's headquarters in the USA. Infrastructure, hardware maintenance, basic software maintenance, security and operation costs are apportioned with those of the enterprise in the USA. The server is not the only one, as another one services the United States, but the enterprise intends to definitely unify the systems, aiming at cost reduction and facility for the consolidation of data. It has already been detected that this centralized architecture will have to adjust to quality and offer of telecommunication services and differences in local systems and businesses practices.

Among the benefits perceived by the enterprise is the ease to get on-line information on the LA activities, including consolidation of the region's results, which facilitates headquarters' control of international activities. As the prior system was carried out in different local servers, consolidation, as well as acquiring of information on transactions performed, took much longer. Other benefit expected by the enterprise is a more efficient administration of inventories in LA. The enterprise claims that there is an ongoing trend towards rationalization in its manufacturing centers of the region, each of them seeking specialization.

The AutoParts Case

AutoParts is an auto parts manufacturer, seated in Europe, that has subsidiaries in more than 100 countries and invoices about US\$ 20 billion per year. In LA the enterprise has plants in Brazil and Argentina and sales offices in Venezuela and Colombia. IT management is done independently, which led to a series of different systems and solutions in the various subsidiaries.

In 1996, the company decided to adopt a plan for the global standardization of its information systems using the R/3 system. The objective was to implement it in all of its facilities until 2004, reaching 75,000 users worldwide. The targets of the project are to reduce IT costs and global integration of its activities. The enterprise sells a number of products manufactured only in certain plants and exported worldwide. The enterprise also has factories that use components produced in units of other countries. Due to this type of operation it is foreseeable that the integration of its systems will produce gains in production planning, internal supply and coordination of the activities in the different countries.

This decision interrupted various processes of ERP systems selection, underway at the time, and which were essentially due to the issue of the year 2000. The Brazilian subsidiary was one of the firsts to implement the R/3, precisely because of that issue. In Europe the enterprise has for a long time been using a R/2 version and therefore was not subject to year 2000 pressures. This allowed the implementation of the R/3 version in its plants with an easier time schedule. However, because the R/3 is not available at headquarters, the benefits expected by integration of the activities of its value chain have not yet been felt.

The first series of R/3 implementations in the subsidiaries has taken place quite independently. After the initial implementations (Brazil, USA, Australia and some plants in Europe), the enterprise noticed that to achieve additional advantages, such as consolidation of results, a definition on a standard configuration would be required. Currently the enterprise has a team from headquarters working on the definition of this model, and because the R/3 is actually implemented in some countries, many installations will need a new configuration. One of the concerns of the Brazilian subsidiary is that the design of the standard

configuration is being performed by an essentially European team, which may lead to difficulties of adjustment to the local culture and business practices.

The enterprise is centralizing its LA IT activities on the team of the Brazilian subsidiary which is implementing the R/3 in the Argentine plant with a server located in Brazil. In this work a series of differences in the conduction of processes and business came to light, as a result of various factors. For instance, one of the differences in business practice among the two countries is that in Argentina collection by banks is not common, whereas in Brazil it is. In the Argentine configuration of the system an additional control of payment by checks was required.

ANALYSIS OF THE PRESENTED CASES

All the enterprises studied intend to implement ERP systems in their diverse subsidiaries to support the coordination of their global activities. The enterprises are still moving towards the construction of these ERP global systems and the benefits currently achieved are limited, taking into account the possibilities that the effective global integration could, in principle, furnish. Besides the integration of activities, the companies under study seek, in the consolidation of results and IT cost reduction, a justification for the globalized use of their systems. Although these findings are in accordance with those observed by King and Sethi (1999), it must be noted that the obtaining of consolidated reports, for the reasons of headquarters' control, and IT cost reductions with servers centralization were cited as the main objectives in all of the cases, and, although global coordination of activities is viewed as an important matter, it is not the driving force of the three surveyed global ERP projects.

Some aspects related to the difficulties with the management of multinational projects, quoted by Ives and Jarvenpaa (1991), were perceived in the case of Bubbles, the only one of the surveyed enterprises that effectively implemented the ERP system at global level. All enterprises reported difficulties regarding communication among people in different countries. Eventually, such difficulties even jeopardized the times and costs initially set for the project.

In AutoParts and Chemicals it was concluded that the use of the ERP system as a global infrastructure is following a learning process. Initially the ERP system was chosen, in a centralized manner in the case of AutoParts and in a decentralized one in the case of the Chemicals. The objectives were to solve local technical problems and to reduce IT costs, with no concern for a global planning of its implementation. After a certain moment the enterprises began to envisage the eventual use of the ERP system on a global scale, focusing their efforts in this direction. The negotiation process to take over the change varied between enterprises, however it was and still is a most significant issue. In the case of Chemicals the subsidiaries need to be convinced; in the case of AutoParts headquarters formed a group for setting of standards; in the case of Bubbles, that already managed IT in a globalized way, and had the standards, the R/3 was elected as world standard under headquarters' jurisdiction.

The need for standardization of data and processes on a world scale for the achievement of real benefits and the difficulty to enable this standardization were aspects found in all of the surveyed cases. The degree of significance of these aspects varied because the enterprises ended by using different strategies for the globalization of their systems. In the case of Bubbles from the beginning of the project it had been decided that standardization should be favored, taking into account the future integration of all systems. In the case of AutoParts and Chemicals implementations were independent and led to differences that are being reviewed so that benefits may be achieved.

CONCLUSIONS

ERP systems are an alternative for the implementation of integrated systems. Notwithstanding that this has been an objective since the enterprises started to use computers, it was never achieved on a large scale through in-house systems development. An important reason was that with isolated systems each department seeks to optimize its operation without greater concern for the enterprise's global context. However, in integrated systems, departments are led to seek optimization of the whole enterprise, leaving local issues on the background. In the not integrated situation efforts are isolated and not related to each other, in the integrated one they are collective and linked. This approach is required by the functionality made available in the integrated packages and impels the users to a new behavior. To summarize, in an isolated system optimization is localized with possible global losses, while in an integrated system optimization is global with the losses being local.

This phenomenon is reproduced on a global scale. But, in this case, there are more encompassing issues than integration between departments. As noted, there are issues of legislation and local culture that also significantly hinder globalization. Differing from the need to integrate the local departments, eventually these hindrances are more difficult to solve and require proper attention. The assessments made do not suggest that the standardization, so insistently pursued by the enterprises, is successful in solving the issue. Clearly, one must live with many more differences in a globalized situation than in that restricted to a single country. The issue of forms and strategies of adjustment for these global differences makes up a very interesting subject for future research.

Just like local implementations, the globalization of systems entails new challenges and requires that new capabilities be incorporated by technology managers and professionals involved. In globalization contexts, to the technical challenges are added those of process management, especially the search for standards and the coordination of project activities. Apparently the difficulties are rooted more in aspects related to language, distance and regional culture than to intrinsic aspects of the subsidiaries that affected local implementations. The assessments suggest that the process of globalization of systems is of an essentially centralizing and authoritative nature and overrides with a certain ease the enterprise's local barriers.

To synthesize, the literature review and the empirical research undertaken suggest that the issue of globalization of systems and especially the globalization supported by means of ERP systems is a not completely explained matter. Nevertheless, technology has currently made it feasible and possibly the enterprises should not disregard this opportunity to search new systems solutions.

REFERENCES

- Holland, C. P. and Light, B. (1999). *A critical success factors model for ERP implementation*. *IEEE Software*, May/June, 30-C36.
- Ives, B. and Jarvenpaa, S. L. (1991). *Applications of global information technology: Key issues for management*. *MIS Quarterly*, March, 33-C49.
- King, W. and Sethi, V. (1999). *An empirical assessment of the organization of transnational information systems*. *Journal of Management Information Systems*, Spring, 7-C28.
- Roche, E. M. (1998). *Global rollouts: A sticky business*. *Computerworld*, December, 7.
- Soh, C.; Kien, S. S. and Tay-Yap, J. (2000). *Cultural fits and misfits: Is ERP an universal solution?* *Communications of the ACM*, April, 47-C51.
- Stephens, D. O. (1999). *The globalization of information technology in multinational corporations*. *Information Management Journal*, July.
- Yin, R. K. (1989). *Case Study Research: Design and Methods*. London: Sage.

Chapter 11: Enterprise Resource Planning and Knowledge Management Systems;^aAn Empirical Account of Organizational Efficiency and Flexibility

Jimmy C. Huang, Nottingham University Business School,
UK

Sue Newell, Royal Holloway, University of London,
UK

Robert D. Galliers, London School of Economics and Political Science,
UK

Shan-Ling Pan, National University of Singapore,
Singapore

Enterprise resource planning (ERP) systems and knowledge management (KM) 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 metaroutines 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 and Cerullo 2000) and the second is knowledge management (KM) systems (Davenport, De Long and 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 co-existed, 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 and 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 and 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 and Malone 1992; Wright and Snell 1998), and more critically, a tradeoff between them (Ghemawat and 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 and March 1963; Epple, Argote and Devadas 1996). Others have emphasized the importance of organizational design for improving efficiency (e.g. Galbraith 1977; Lawrence and 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 and Cixon 1999). A more radical approach is seen in the literature on business process reengineering (BPR) (e.g. Davenport 1992), 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 and 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 and 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 and 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 and 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 and Hambrick 1997), absorptive capacity (Cohen and Levinthal 1990) and boundary spanning (e.g. Tushman and 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 and Malone 1992) and innovation (e.g. Clark and Staunton 1989; Doherty 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 non-routine 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 and 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 and Scott 1999), developing a KM strategy (Hansen, Nohria and Tierney 1999) and implementing a KM system (Davenport and 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 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 website 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 Wipp (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, Goldoftas and Levine (1999).

ERP and KM: Differences and Similarities in Characteristic

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 and Kaindl 2000; Soliman and 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 and 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 and 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 and Scarbrough 1999) and Celltech (McNamara and 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 and Duguid 1991; Wenger and 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 and 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 re-arrangements 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 and 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 inter-organizational 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 and Whipp 1991).

Content: Information vs. Knowledge

Similar to other empirical studies (e.g. Al-Mashari and 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 and Duguid 1991; Orr 1991). 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 and 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 organization's information processing capability strongly influences how knowledge can be effectively created, exploited and captured (Hackbarth and Grover 1999; Nambisan et al 1999; Tenkasi and Boland 1996). And the distribution and availability of knowledge determines the way in which information is interpreted by organizational members (Huber 1991; Shrivastava and 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 and 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 and 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 engine, 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. Inter-organizational

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 lead 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 was 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 initiative 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 and Konno 1998; von Krogh et al. 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 inter-organizational 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 et al 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 partnerships. 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 and Hilleggerberg 2000). In addition, the implementation of KM was found to facilitate the effective and systematic exploitation of knowledge (March 1991) intra-and inter-organizationally, and improve continuous learning from past actions for future actions (Fiol and 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 inter-organizational social process had been altered and reshaped through the implementation of the two initiatives. This change was evident in the occurrence of inter-group 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, has been observed in other empirical observations of organizational change (e.g. Hutt et al 1995; Kirkman and 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 and

Burkardt 1993).

Moreover, the alteration of inter-organizational 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 and Ghoshal 1998), which had been developed overtime. 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 tradeoff 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: metaroutines, enrichment, switching and partitioning. According to them, metaroutines, 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 pre-selected 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 non-routinized, coinciding with other empirical accounts (e.g. Martiny, 1998 and 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 and Stalker 1961; Lawrence and Lorsch 1967). In this sense the ERP system had encouraged partitioning, with different divisions specializing in either routine or non-routine 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 inter-organizational 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 emphasize 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.

REFERENCES

- Adler, P., Goldoftas, B., & Levine, D. (1999). *Flexibility versus efficiency? A case study of model changeovers in the Toyota production system*. *Organization Science* 10, 43–68.
- Al-Mashari, M. & Zairi, M. (2000). *Supply-chain re-engineering using enterprise resource planning (ERP) systems: An analysis of a SAP R/3 implementation case*. *International Journal of Physical Distribution & Logistics* 30, 296–313.
- Anderson, D., Britt, F., & Favre, D. (1997). *The seven principles of supply chain management*. *Supply Chain Management Review* 1, 31–41.
- Argote, L. (1982). *Input uncertainty and organisational coordination in hospital emergency units*. *Administrative Science Quarterly* 27, 420–434.
- Birchall, D. and Tovstiga, G. (1999). *The strategic potential of a firm's knowledge portfolio*. *Journal of General Management* 25, 1–16.
- Blackler, F. (1995). *Knowledge, knowledge work and organizations: An overview and interpretation*. *Organization Studies* 16, 1021–1046.
- Brand, A. (1998). *Knowledge Management and Innovation at 3M*. *Journal of Knowledge Management* 2, 17–22.
- Brass, D. & Burkardt, M. (1993). *Potential power and power use: An investigation of structure*. *Academy of Management Journal* 36, 441–472.
- Brooks, A. (1994). *Power and the production of knowledge: Collective team learning in work organizations*. *Human Resource Development Quarterly* 5, 213–235.
- Brown, J. & Duguid, P. (1991). *Organizational learning and communities of practice: Toward a unified view of working, learning and innovation*. *Organization Science*, 2, 40–56.
- Brown, R. & Woodland, M. (1999). *Managing knowledge wisely: A case study in organizational behavior*. *The Journal of Applied Management Studies* 8, 175–198.
- Bryman, A. (1989). *Research methods and organizational studies*. London: Unwin Hyman.
- Burns, T. & Stalker, G. (1961). *The management of innovation*. London: Tavistock.
- Cerullo, M. & Cerullo, V. (2000). *The internal auditor's role in developing and implementing enterprise resource planning systems*. *Internal Auditing* 15, 25–34.
- Clark, P. & Staunton, N. (1989). *Innovation in technology and organization*. London: Routledge.
- Cohen, M. & Levinthal, D. (1990). *Absorptive capacity: A new perspective on learning and innovation*. *Administrative Science Quarterly* 35, 128–152.
- Communications of ACM. (2000) *Special issue on enterprise resource planning (ERP) systems*, 43.
- Cyert, R. M. & March, J. C. (1963). *A behavioral theory of the firm*. Oxford: Blackwell.
- Davenport, T. H. (1993). *Process innovation: Reengineering through information technology*. Boston: Harvard Business School Press.
- Davenport, T. H. (1998). *Putting the enterprise into the enterprise system*. *Harvard Business*

Review 76, 121~C131.

Davenport, T., De Long, D., & Beers, M. (1998). *Successful knowledge management projects*. *Sloan Management Review* 39, 43~C57.

Davenport, T. H. & Prusak, L. (1998). *Working knowledge: How organizations manage what they know*. Boston: Harvard Business School Press.

Davidow, W. & Malone M. (1992). *The virtual corporation, structuring and revitalizing the corporation for the 21st century*. New York: Harper Business.

Demsetz, H. (1991). *The theory of the firm revisited*. In O. Williamson & S. Winter (Eds.), *The nature of the firm*. Oxford: Oxford University Press.

Denzin, N. K. (1988). *The research act*. New York: McGraw-Hill.

Dollinger, M. (1984). *Environmental boundary spanning and information processing effects on organizational performance*. *Academy of Management Journal* 27, 351~C368.

Douherty, D. (1992). *A practice-centered model of organizational renewal through product innovation*. *Strategic Management Journal* 13, 77~C92.

Earl, M. and Scott, I. (1999). *Opinion: What is a chief knowledge officer?* *Sloan Management Review* 40, 29~C38.

Epple, D., Argote, L., & Devadas, R. (1996). *Organizational learning curves: A method for investigating intra-plant transfer of knowledge acquired through learning by doing*. In M. Cohen and L. Sproull (Eds.), *Organizational learning*. London: Sage.

Fincham, R. (1999). *The consultant-client relationship: Critical perspectives on the management of organizational change*. *Journal of Management Studies* 36, 335~C351.

Fiol, C. M. & Lyles, M. A. (1985). *Organizational learning*. *Academy of Management Review* 10, 803~C813.

Frohlich, M. & Cixon, J. R. (1999). *Information systems adaptation and the successful implementation of advanced manufacturing technologies*. *Decision Sciences* 30, 921~C957.

Galbraith, J. (1977). *Organizational design*. Reading: Addison-Wesley.

Galliers, R. D. & Newell, S. (2000). *Back to the future: From knowledge management to data management*. LSE Information Systems Department. Working Paper Series #92. <http://is.lse.ac.uk/wp/locate.asp>.

Galuni, D. C. & Rodan, S. (1998). *Resource recombination in the firm: Knowledge structures and the potential for Schumpeterian innovation*. *Strategic Management Journal* 19, 1193~C1201.

Geletkanycz, M. & Hambrick, D. (1997). *The external ties of top executives: Implications for strategic choice and performance*. *Administrative Science Quarterly* 42, 654~C681.

Ghemawat, P. & Costa, R. (1993). *The organizational tension between static and dynamic efficiency*. *Strategic Management Journal* 14, 59~C73.

Grant, R. (1996). *Prospering in dynamically-competitive environment: Organizational capability as knowledge integration*. *Organization Science* 7, 375~C387.

Gurteen, D. (1998). *Knowledge, creativity and innovation*. *Journal of Knowledge Management* 2, 5~C13.

- Hackbarth, G. & Grover, V. (1999). *The knowledge repository: Organizational memory information systems*. *Information Systems Management* 16, 21-C30.
- Hannan, M. & Freeman, J. (1989). *Organizational ecology*. Cambridge: Harvard University Press.
- Hansen, M., Nohria, N., & Tierney, T. (1999). *What's your strategy for managing knowledge?* *Harvard Business Review* 77, 106-C116.
- Huber, G. (1991). *Organizational learning: The contributing processes and the literatures*. *Organization Science* 2, 88-C115.
- Hutt, M., Walker, B., & Frankwick, G. (1995). *Hurdle the cross-functional barriers to strategic change*. *Sloan Management Review* 36, 22-C30.
- Jones, A. & Hendry, C. (1994). *The learning organization: Adult learning and organizational transformation*. *British Journal of Management* 5, 153-C162.
- Kirkman, B. & Shapiro, D. (1997). *The impact of cultural values on employee resistance to teams: Toward a model of globalized self-managing work team effectiveness*. *Academy of Management Review* 22, 730-C757.
- Kogut, B. & Zander, U. (1992). *Knowledge of the firm, combinative capabilities, and the replication of technology*. *Organization Science* 3, 383-C397.
- Lawrence, P. & Lorsch, J. (1967). *Organisation and Environment: Managing differentiation and integration*. Cambridge: Harvard University Press.
- Lipnack, J. & Stamps, J. (1997). *Virtual teams: Reaching across space, time, and organizations with technology*. Chichester: John Wiley & Sons.
- March, J. (1991). *Exploration and exploitation in organizational learning*. *Organization Science* 2, 71-C86.
- Martiny, M. (1998). *Knowledge management at HP Consulting*. *Organizational Dynamics* 26, 71-C84.
- McNamara, P. & Baden-Fuller, C. (1999). *Lessons from the Celltech case: Balancing knowledge exploration and exploitation in organizational renewal*. *British Journal of Management* 10, 291-C307.
- Miles, M. B. & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. London: Sage.
- Nadler, D. (1981). *Managing organizational change: An integrative perspective*. *The Journal of Applied Behavioral Science* 17, 191-C211.
- Nahapiet, J. & Ghoshal, S. (1998). *Social capital, intellectual capital, and the organizational advantage*. *Academy of Management Review* 23, 242-C266.
- Nambisan, S., Agarwal, R., & Tanniru, M. (1999). *Organizational mechanisms for enhancing user innovation in information technology*. *MIS Quarterly* 23, 365-C 395.
- Nonaka, I. and Konno, N. (1998). *The concept of i°ba j±: Building a foundation for knowledge creation*. *California Management Review* 40, 40-C54.
- Nonaka, I. and Takeuchi, H. (1995). *The knowledge-creating company*. Oxford: Oxford University Press.
- Orlikowski, W. & Robey, D. (1991). *Information technology and the structuring of organizations*. *Information Systems Research* 2, 143-C169.

- Orr, J. (1990). *Sharing knowledge, celebrating identity: War stories and community memory in a service culture*. In D. Middleton and D. Edwards (Eds.), *Collective remembering: Memory in society*. London: Sage.
- Palaniswamy, R. & Frank, T. (2000). *Enhancing manufacturing performance with ERP systems*. *Information Systems Management* 17, 43-C55.
- Pan, S-L. & Scarbrough, H. (1999). *Knowledge management in practice: An exploratory case study*. *Technology Analysis & Strategic Management* 11, 359-C374.
- Pereira, R. E. (1999). *Resource view theory analysis of SAP as a source of competitive advantage for firms*. *Database for Advances in Information Systems* 30, 38-C46.
- Pettigrew, A. & Whipp, R. (1990). *Managing change for competitive success*. Oxford: Blackwell.
- Pfeffer, J. (1981). *Management as symbolic action*. In L. Cummings and B. Staw (eds.), *Research in organizational behavior*. London: JAI.
- Pisano, G. (1994). *Knowledge, integration, and the locus of learning: An empirical analysis of process development*. *Strategic Management Journal* 15, 85-C100.
- Scott, J. & Kaindl, L. (2000). *Enhancing functionality in an enterprise software package*. *Information & Management* 37, 111-C122.
- Senge, P. (1990). *The fifth discipline, the art and practice of the learning organisation*. London: Century Business.
- Shrivastava, P. & Schneider, S. (1984). *Organizational frames of reference*. *Human Relations* 37, 795-C809.
- Soliman, F. & Youssef, M. (1998). *The role of SAP software in business process re-engineering*. *International Journal of Operations & Production Management* 18, 886-C895.
- Spender, J. C. (1996). *Making knowledge the basis of a dynamic theory of the firm*. *Strategic Management Journal* 16, 45-C62.
- Stake, R. (1995). *The Art of Case Study Research*. London: Sage.
- Starbuck, W. (1992). *Learning by knowledge intensive firms*. *Journal of Management Studies* 29, 713-C740.
- Strauss, A. & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. London: Sage.
- Tenkasi, R. & Boland, R. Jr. (1996). *Exploring knowledge diversity in knowledge intensive firms: A new role for information systems*. *Journal of Organizational Change Management* 9, 79-C91.
- Tsoukas, H. (1994). *Refining common sense: Types of knowledge in management studies*. *Journal of Management Studies* 31, 761-C780.
- Tushman, M. & Scanlan, T. (1981). *Boundary spanning individuals: Their role in information transfer and their antecedents*. *Academy of Management Journal* 24, 289-C305.
- Volberda, H. (1996). *Toward the flexible form: How to remain vital in hypercompetitive environments*. *Organization Science* 7, 359-C374.
- von Krogh, G., Ichijo, K., & Nonaka, I. (2000). *Enabling knowledge creation*. Oxford: Oxford University Press.

Wagle, D. (1998). *The case for ERP systems*. *The McKinsey Quarterly* 9, 130-138.

Wenger, E. & Snyder, W. (2000). *Communities of practice: The organizational frontier*. *Harvard Business Review*, 78, 139-145.

Wilson, B. (1984). *Systems: concepts, methodologies, and applications*. Chichester: John Wiley & Sons.

Wright, P. & Snell, S. (1998). *Toward a unifying framework for exploring fit and flexibility in strategic human resource management*. *Academy of Management Review*, 23, 756-772.

Yin, R. K. (1984). *Case study research- design and methods*. London: Sage.

Zbaracki, M. (1998). *The rhetoric and reality of Total Quality Management*. *Administrative Science Quarterly*, 43, 602-636.

Chapter 12: The ERP Marketplace;^aAn Australian Update

Andrew Stein, Paul Hawking, Victoria University of Technology, Melbourne, Australia

The global ERP industry blossomed in the 1990's automating back office operations. The Australian ERP industry matched this global trend and has kept pace with the latest amalgam of front office applications including CRM, demand planning and sales-force automation being merged with the traditional ERP applications. ERP vendors are frantic in their attempts to ride the "E" wave whilst ERP customers struggle with the people, process and technology implications that ERP brings. This paper presents the preliminary results of an analysis of the Australian ERP market place. This study looks at the market movement and demographics of SAP, the dominant ERP vendor within the Australian marketplace.

ERP IN AUSTRALIA

ERP Marketplace

A recent Boston Consulting Group report (BCG, 2000) on the Australian ERP marketplace found that executives reported that only 33 percent of ERP implementations were successful. The metrics used to report success included value creation, cost-effectiveness and tangible financial impact. This report also reported significant vendor dissatisfaction among client executives. ERP vendors (Bell, 2000) balance this dissatisfaction by reporting that organisations have trouble identifying the value adding processes that a large scale ERP implementations will augment. The six main vendors in the Australia, SAP, Peoplesoft, Baan, Oracle, JD Edwards and Great Plains have dominated the large organisation marketplace. In analysing any large scale ERP suite payback and ROI are crucial to measures of success. A Deloitte Consulting Report (Deloitte, 1999) identified a number of expected benefits from ERP, these include cost reductions, inventory reduction and cycle time reduction. Identifying the back-office ROI has been a struggle in most large Australian organisations (Chung, 2000). As in the global marketplace Australian enterprises have struggled with the large-scale change necessary in ERP. Weston Foods implemented one of the largest SAP installations in Australia in 1999 and their finance director Douglas Forgie (Bass, 1999) commented on the need to change organisational culture when implementing ERP. This point is supported by John Julian (Forsyth, 1999), director of Information systems at Monash University, when they implemented a SAP back office HR/Finance system. He commented that any ERP implementation is more a people rather than a technical problem.

ERP and the Internet Marketplace

The move in the 1990's to adopt integrated ERP systems at the expense of best of breed solutions is now being reversed as E-Business (Freedman, 1999) is now dominating front office applications. Worldwide there is a move to find a viable business model for B2B on-line exchanges. AMR research (McKenna, 2000) reports that lower transaction costs will drive the B2B marketplace and will force a consolidation with major B2B companies claiming market dominance. Based on a survey of Fortune 1000 companies AMR predict the B2B (McKenna, 2000) marketplace will be worth US\$5.7 trillion by 2004. The need to extend the reach of technology into the front office and the external driver of E-Business has forced both enterprises and ERP vendors (Gartner, 1998) to adopt flexible approaches to Customer Relationship Management (CRM), supply chain management, call-centres and E-Commerce. Vertical, canned and component based implementations addressing supply-chains, customer and marketing channels are emerging as the dominant ERP strategy for the coming decade (Chung, 2000). To accommodate the E-Business wave SAP AG is using the mySAP.com strategy to develop B2B marketplaces, role based portals, business applications and application hosting services to role out internet based capability.

Australian MySap.com Marketplaces

In the Asia-Pacific region there are 114000 mySAP.com workplace users (Roach, 2000) in 201 installations. The workplace concept has been extended through the use of mySAP.com mobile workplace. SAP Hosting and SAP Markets are leading SAP's foray into creating globally interconnected B2B marketplaces. The Asia Pacific region has five mySAP.com marketplaces providing commerce,

collaboration, content and community service within the wider community. In January 2000, SAP Australia and Telstra launched the largest B2B marketplace in the Asia Pacific region. This market place is a procurement portal consisting of 11 major Australian corporations. The marketplace concept includes horizontal, vertical, channel as well industry type marketplaces. The mySAP.com workplace portal will allow organisations to develop applications covering CRM, supply chain management, E-Commerce buying, product lifecycle management, business intelligence and strategic enterprise management. The Australian market place is advantaged by adopting a second adopter strategy, using the latest technology that has been tried and tested in larger marketplaces and skipping earlier lesson cycles (Chung, 2000). Many studies (Holland, 1999; Reel, 1999; Brown, 1999; Somers, 2000) have proposed success factors for ERP implementations. Some common factors in these studies include, management support, user training, management of expectations and vendor/client relationship. In the age of E-Business will a new set of success factors emerge? A crucial question for enterprises will be the management of their span of operations. The traditional ERP should be good at managing the integrated data within the organisation, but all enterprises will need to manage the broader information chain within the E-Business supply chain (Chung, 2000). Enterprises will need to decide if their ERP vendor will provide the interface between the back-office transaction systems and the customer/marketing component based systems.

METHODOLOGY

ERP Study Objectives

The primary objective of the study was to survey a range of ERP clients and seek responses to a range of issues confronting enterprises within the Australian marketplace. SAP Australia was chosen as the study vector as it dominates (IDC, 1999) the ERP market in Australia. The first part of the study as presented in this paper will provide an analysis of SAP clients in Australia. Clients will be analysed by:

- Date, industry sector and organisation size;
- Modules implemented; and
- Database, operating system and vendor.

The second part of this study will be to survey the SAP cohort to explore two main ERP issues, the impact of ERP systems upon the job progression and skills mix of IS professionals and the changing nature of ERP success factors. Several key issues will be addressed by these future studies:

- Plans for merging back-office ERP and front office applications ie CRM;
- Career planning for IS professionals in ERP organisations;
- Impact of emerging mySAP.com E-Business applications upon existing ERP staff skill sets;
- Exploration of the success metrics for back-office versus front-office applications; and
- How existing companies are adapting to the emerging B2B marketplace.

Research Methodology

SAP Australia provided two customer data files. The first was the customer file, this contained client name, contact, implementation date and type. The second file contained name, go-live date and module information. The two files were combined into a database and cross-referenced with external sources to include financial data pertinent to the enterprises. This information was confidential and provided to Victoria University's School of Information Systems due to is a membership of the SAP University Alliance Program. This data was then loaded in SPSS v10 and analysed with standard statistical measures.

RESULTS

Customers

SAP has approximately 13,000 customers in 120 countries. SAP defines a customer as an organisation using SAP software. In Australia and New Zealand this includes SAP itself, the 15 universities which are part of SAP University Alliance, and SAP implementation partners in addition to the traditional business users of the software. From 1994 to July 2000 387 customers implemented a version of SAP's R/3 software. This does not include update or upgrade implementations. A break down for the first year a customer implemented SAP R/3 is included in [Table 1](#).

Table 1: Customer Implementations (N=387) by Year

Year	Number of Implementations
1994/1995	10
1996	32
1997	50
1998	96
1999	56
2000 wip	143

The large numbers of implementations for 2000 include those being worked up into go-live. This would include all instances of projects that are work in progress. The data indicated that the 387 customers represent 711 instances of SAP R/3. An instance is a separate implementation of SAP R/3 usually for the purpose of handling data for a separate company within the overall enterprise or used to support some of the SAP's new dimension products such as data warehousing, customer relationship management, etc. Of the 387 customers 329 were based in Australia and 58 in New Zealand.

The customers are spread across all industry sectors as defined by the Australian Bureau of Statistics Industry ([Table 2](#)). Public Administration is the dominant sector with customers at both the Federal and State levels. At the state level New South Wales and Queensland governments are the main customers.

Table 2: Customers (N=387) by Industry Type

Industry Type	% of Customers	Industry Type	% of Customers
Public Administration	27%	Manufacturing	19%
Wholesale & Retail	17%	IT services	3%
Agriculture & Mining	12%	Transport & Storage	4%
Utilities & Construction	5%	Community Services	1%
Finance & Business Services	4%	Other Services	8%

SAP uses its own industry sectors to categorise its customers as illustrated in [Table 3](#). There appears to be additional categories included for the Australian market that would be included in other categories on the worldwide figures. It must be remembered that the worldwide data would include the data for Australia and the Australian data would be influenced by the relatively small sample. The major differences in percentage figures are in the Public Sector, Higher Education and Research, and Health Sectors. The Public Sector category maybe a reflection of the multiple levels of the Australian Government and each department is classified as a customer. However, anecdotally SAP admits that they have a very high market penetration in this sector compared to the rest of the world.

Table 3: Customers by SAP Industry Type; Australia and Worldwide

Industry sector	Australia Customers(N=387) %	World Customers (N=17,583) %
Building Materials, Clay & Glass	1.8% ^[*]	

Forest Products & Paper	2.3%	2.80%
Metal Products	2.1% ^[*]	
Primary Metal & Steel	2.6% ^[*]	
Sap Aerospace & Defence	0.8%	1.50%
Sap Automotive	2.3%	5.40%
Sap Banking	2.3%	2%
Sap Chemicals	5.4%	8.50%
Sap Consolidated Companies	0.5% ^[*]	
Sap Consumer Products	8.3%	9.70%
Sap Engineering & Construction	2.6%	9.70%
Sap Healthcare	0.5%	2.40%
Sap High Tech & Electronics	5.9%	11.10%
Sap Higher Education & Research	5.2%	0.70%
Sap Insurance	1.6%	1.90%
Sap Media	2.6%	2.20%
Sap Mining	4.1% ^[*]	
Sap Oil & Gas	2.3%	3.20%
Sap Pharmaceuticals	2.1%	3.10%
Sap Public Sector	16.5%	3.00%
Sap Retail	5.9%	6.40%
Sap Service Provider	11.4%	10%
Sap Telecommunications	2.8%	3.40%
Sap Utilities	4.4%	4.10%
Textiles Production	1.3% ^[*]	
Transportation & Storage	2.3% ^[*]	
[*]SAP worldwide have an Other category at 11.9%		

The discrepancy for the difference in sales in the Higher Education and Research sector can be partially explained by how SAP Australia classifies its customers. SAP Australia has recently included the 15 universities that are part of SAP University Alliance program as part of this sector. These universities receive the software free of any cost as distinct to the 3 universities within Australia that are using SAP R/3 as a business system. SAP sells a Higher Education and Research version to support universities. It would appear that the worldwide figures might only include universities that have purchased the software.

An explanation for the difference in the Health sector figures can not be put forward at this moment, but similar to many of the other sectors it provides a basis for future research on SAP market penetration in different regions around the world.

The size of the enterprise is an important factor when considering the market penetration. Traditionally SAP was restricted larger organizations due to its complexity and associated costs. This is reflected in the following figures that illustrate the level of SAP penetration in the USA:

- 6 out of top 10 Fortune 500 companies,
- 7 out of the top 10 most profitable companies,
- 7 out of the top 10 pharmaceutical companies,
- 7 out of the top 10 computer companies,
- 7 out of the top 10 petroleum companies,
- 7 out of the top 10 electronics companies,

- 7 out of the top 10 chemical companies, and
- 7 out of the top 10 food companies (Curran and Kellar, 1998).

The above figures indicate that towards the end of the 90's the SAP market in large organisations had become limited and alternative markets were needed. SAP has developed a number of strategies to reduce implementation costs in an attempt to make their software more affordable to mid-range organisations. The Australian customer data can be classified by revenue to provide an indication of the size of companies implementing SAP software (Table 4). As would be expected large organisations (32%) dominate the client base. The SME grouping at 20% shows the move of SAP down into the smaller market demographic has been successful. The large number reported as other (40%) would indicate some work in progress implementations as well as the difficulty to categorise organizations due to the public sector customers and the lack of financial data for other customers. More work categorising the other grouping would be beneficial.

Table 4: Customers (N=387) by Size (Client Revenue)

Size \$ 1000's	Customers
Large (>1000)	124 32%
Large/Medium (500~1000)	12 3%
Medium/Small (50~500)	76 20%
Small (<50)	16 5%
Other	154 40%

Implementations

SAP has released a number of versions of their software since the company's inception. The major releases are R/2 which was a mainframe based system, R/3 which is based on client server technology and the "New Dimension" products which are now packaged with SAP R/3 under the banner of mySAP.com with the E-Commerce components Workplace and Marketplace. The "New Dimension" products include Customer Relationship Management (CRM), Data Warehousing (BW), Knowledge Management (KM), Advanced Planner and Optimiser (APO), and Strategic Enterprise Management (SEM).

The breakdown for SAP software versions for Australian customers by instance is presented in Table 5. SAP R/3 version 3.1 dominates the market place and this indicates that a large number of SAP's customers are faced with upgrading in the new future, especially if they want to take advantage of the new E-Commerce functionality.

Table 5: Implementations (N=387) by Release

Release	Implementations (no.)	Implementations (%)
New Dimension		
APO	22	3%
BW	75	11%
CRM	52	7%
KM	5	1%
SEM	8	1%
SAP R/2	14	2%
SAP R/3		
unspecified	60	8%
2.0	11	2%
3.0	45	6%
3.1	161	23%
4.0	103	14%

4.5	76	11%
4.6	79	11%

The SAP supplied data included a comment field where customers indicated their upgrade strategy. Table 6 shows that up to 140 of the installed SAP client base are undertaking upgrades into the internet enabled versions of SAP. This is important given the move into marketplaces and portals mentioned previously.

Table 6: Upgrade Versions (N=387) by Release

Release	Number of Implementations
4.0B	4 1%
4.5B	28 7%
4.5 long term(6mths)	24 6%
4.6	32 8%
4.6B	74 19%
4.6C	2 0%
4.6 long terms(6mths)	59 15%

SAP R/3 software is an open system, which can operate under a variety of operating systems on differing hardware platforms utilising a number of database technologies. The breakdowns for SAP operating systems and database platforms are presented in Table 6. The main trends evident are the domination of the O/S by the various flavours of Unix platforms with the majority of these instances utilising an Oracle database. Oracle is the database of choice on all operating systems. Hardware platforms are spread evenly and further breakdown based upon industry sector would be beneficial.

Modules

SAP R/3 is modular based software. Due to the software's complexity customers usually implement only a few modules a time. A preliminary analysis of the modules implemented by some customers is presented in Table 8. As would be expected the majority of customers had implemented the financial related modules (Financial Accounting and Controlling). It appears that many of the public sector companies have implemented HR based modules. Material Management modules depict the manufacturing flavour of many SAP implementations.

Table 7: Implementations (N=386) by Operating System, Hardware & Database Platform.

Operating System	Number of Imps	Hardware Platform	Number of Imps	Database Platform	Number of Imps
AIX	50 13%	COMPAQ	55 14%	DB2/400	25 6%
DEC-UNIX	30 8%	DELL	50 13%	INFORMIX	30 7%
HP-UX	44 11%	HP	52 13%	MSSQL	65 17%
NT/ALPHA	11 3%	IBM	96 25%	ORACLE	241 62%
NT/INTEL	130 34%	SUN	55 14%	Other	25 7%
OS/400	16 4%	DEC	45 12%		
SOLARIS	50 13%	SNI	25 7%		
Other	55 14%	Other	8 2%		

Table 8: Implementation Modules by %

Module	%	Module	%
Material Management	48	Production Planning	24
Financial Accounting	65	Basic Components	19
Controlling	58	Treasury	18
Sales & Distribution	37	HR-Payroll Accounting	54

Project System	16	HR-PD	14
Plant Maintenance	21		

Discussion

ERP vendors as well as organisations are struggling to find stability in the emerging B2B E-Business marketplace. The B2B business model promises lower transaction costs, as well strategic advantage in procurement and supply chain management. Large-scale ERP vendors are struggling to connect their back office systems with Web enabled access. The portal or B2B marketplace will gain acceptance as advantages are measured. The Australian marketplace continues to follow other major business marketplaces and are now exploring the B2B portal as a new business model. SAP companies are upgrading to the Web enabled model (V4 & above) and also exploring creating consortium portals.

Stage two and three of the project requires targeted and widespread information gathering utilising contacts from the SAP mailing list. Three organisational contacts are provided with each organisation and email will be used to contact respondents. Stage two will collect information relating to career planning and skill development amongst the cohort. The public administration cohort will be targeted as a pilot survey with questions relating to previous, current and future job-roles, education, training and information skill-sets. Each of the three organisational contacts will be emailed with the survey and requested to reply after filling in the survey. Several studies (Dillman, 1998; Mehta, 1995) have compared email versus mail information collection methods and have demonstrated the viability of collecting information through email. Comley (1995) found that email surveys compared favourably with postal methods in the areas of cost, speed, response quality and response rate. The use of an email directing the respondent to a web site will also be investigated pending analysis of the trail survey. Once the trail has been completed and analysed the whole cohort will be sampled.

Stage three of the project will utilise lessons learnt form stage two and obtain a picture of the success factors that the entire cohort see as crucial in the ERP system. Special emphasis will be placed on the potential changing nature of success factors with the merging of back-office and front office applications. Respondents will be given a list of success factors obtained from previous studies and then asked to rank them. They will also be asked to develop new factors through the use of open-ended questions. Analysis will be based upon industry type, application maturity and respondent position.

REFERENCES

- Bass, J. (1999). *ERP arms race. MIS Australia ERP Supplement*, November, 8°C12.
- Bell, C. (2000). *Who's to blame. MIS Australia*, June, 33°C38.
- Boston Consulting Group. (2000). *Getting Value From Enterprise Initiatives: A Survey of Executives*, March. Boston, MA: Boston Group.
- Brown, C. and Vessey, I. (1999). *ERP implementation approaches. Proceedings of the Twentieth international Conference on Information Systems*, 411°C416, Charlotte, NC
- Chung, D. (2000). *Where to next? MIS Australia*, February, 42°C46.
- Comley, P. (1996). *The use of the Internet as a data collection method. Media Futures Report*. London: Henley Centre.
- Curran, T. and Kellar G. (1998). *SAP R/3 Business Blueprint*. Englewood Cliffs, NJ: Prentice Hall.
- Deloitte Consulting. (1999). *ERP's Second Wave*, June.
- Dillman, D. (1998). *Mail and other self-administered surveys in the 21st century: The beginning of a new era. Discussion paper of the Social and Economic Sciences Research Centre*, Washington State University, Pullman.
- Forsyth, A. (1999). *ERP arms race. MIS Australia ERP Supplement*, November, 16°C20.
- Freedman, R. (1999). *ERP beyond Y2K. PC Magazine*, June 22, 219.
- Gartner Group. (1998) *CFO and CPA Survey*, July, Gartner Group.
- Holland, C. P. and Light, B. (1999). *A critical success factors model for ERP. IEEE Software*, 16(3), 30°C36.
- IDC. (1999). *ERP Market Statistics*.
- McKenna, T. (2000). *Firms Target Market for Setting Up B2B Exchanges*. Retrieved July 27, 2000 from the World Wide Web: <http://www.telekomnet.com/>.
- Mehta, R. and Sivadas, E. (1995). *Comparing response rates and response content in mail versus electronic mail surveys. Journal of the Market Research Society*, 37, 429°C439.
- Reel, J. S. (1999). *Critical success factors in software projects. IEEE Software*, 16(3), 18°C23.
- Roach, J. (2000). *Eighty-five thousand users in Asia Pacific prove success of mySAP.com. SAPPHIRE 2000*, Brisbane, Australia.
- Somers, T. T., Nelson, K. and Ragowsky, A. (2000). *ERP for the next millenium. Proceedings of the American Conference on Information Systems*, August.

Chapter 13: A Framework for Assessing ERP Systems Functionality for the SMEs in Australia

Liaquat Hossain, Syracuse University,
USA

Mohammad A. Rashid, Massey University, Albany,
New Zealand

Jon David Patrick, The University of Sydney,
Australia

Anticipating the use of the ERP systems among small-to-medium enterprises (SMEs) to be the future area of growth ERP vendors such as SAP, Oracle, PeopleSoft, JDEdwards and Bann are introducing ERP software that appeal 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-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. 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 percent 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 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-Weakness-Opportunity-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, JDEdwards and Bann. This provides not only a comparison of the ERP products offered by five leading vendors, but also to provide 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 provides 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 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 environmental (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 and 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, JDEdwards 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 Website <http://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 represents 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;^aCritical 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 tradeoffs, 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 understanding 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 modelling is often used in documentation. A scribe often liaises 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)

The 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 and Laudon, 1998). Rockart (1982), 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:

- i. can be shaped by the industry and its structural changes;
- ii. the firm's operational strategies and changes in the products/services offered;

- iii. the manager and his/her perceptions towards the success factors of a firm; and,
- iv. 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 makes the manager's investment decisions more complex. Research by Daniels (1994) 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 understanding 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 develop 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 CSF's. 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.

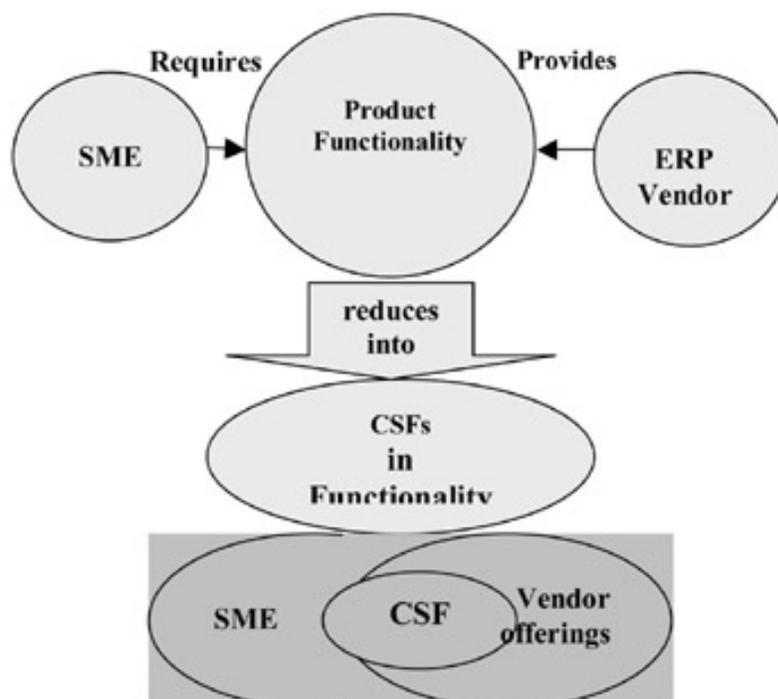


Figure 1: The conceptual model of the study

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 is 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 percent of the Australian ERP market. The five major software vendors such as SAP, Oracle, JDEdwards, 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 percent of the local ERP vendor market and with an annual turnover of approximately US\$93 million. It is estimated that about 50 percent 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 are all integrated into a workflow 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 Business Information Warehouse (BIW). [Table 1](#) summarizes the SWOT findings for SAP.

Table 1: The SWOT of SAP

SWOT Crireria	Findings
Strengths	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • SAP's solutions do not provide solutions for all companies and claims that companies who provide more specialised solutions offer better value for money. • SAP contracts are often delivered over time and over budget due to the difficulty in 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	<ul style="list-style-type: none"> • A trend towards e-commerce, netcentric computing through implementations of XML, ASP, Java.
Threats	<ul style="list-style-type: none"> • Competing best of breed or more compact solutions that are more attractive to SME's.
Customers	<ul style="list-style-type: none"> • 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 six percent of the local market. Similar to SAP, Baan has a strong manufacturing focus in the local market. 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 Microsoftbased 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 and reduces the challenges faced by sales forces and aims 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 financial team on planning and analyzing. Other tools include *Strategic enterprise management* which consist 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	<ul style="list-style-type: none"> • Baan's outsourcing of web site assists midsize customers with ERP outsourcing decisions.
Weaknesses	<ul style="list-style-type: none"> • Risky financial position. • Baan relies heavily on local partners in the form of consultants and systems integrators to provide implementation skills.
Opportunities	<ul style="list-style-type: none"> • Shift to e-commerce and focus on SME's. • Take-up of emerging technologies such as XML.
Threats	<ul style="list-style-type: none"> • A lack of market share and financial stability. • Larger ERP competitors.
Customers	Baan's main clients include Deloitte and Touch's consulting arm ICS who have announced that it recently had been chosen to support localised Baan components. Others include Western Power, Power New Zealand, Walker's Ltd and Metal Manufactures Limited.

JDEdwards

US companies control approximately 32 percent 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 provide innovative, flexible solutions essential in running complex and fast-moving multinational organizations. They also assist companies of small to medium sizes influencing existing investments, take advantage of new technologies, and maintain competitive advantage.

One World 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 JDEdwards' clients. *E-Business, Supply Chain Management* JDEdwards 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 *Streamline 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 CAims to improve the customer life cycle^a from identifying prospects and closing sales to order entry, fulfilment, service, and support. JDEdwards CRM aims to generate new business opportunities, revenue potential and also extend the supply chain to customers. *Knowledge Management* CAims 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 CThis 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* CBrings 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	<ul style="list-style-type: none"> • JDEdward's products are very flexible since their participating outsourcers are competent with JDEdwards 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. • JDEdwards' 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 1000 B2B, e-commerce, and web-enabled modules/applications. • JDEdwards has good vendor support from Hewlett Packard, one of the main 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	<ul style="list-style-type: none"> • JDE has narrow industry coverage when compared to a vendor like SAP. JDEdwards 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. • JDEdwards cannot compete with SAP/Oracle in research and development.
Opportunities	<ul style="list-style-type: none"> • Combination of industry leading in B2B, e-commerce, e-business solutions. • New technologies such as XML.
Threats	<ul style="list-style-type: none"> • Larger ERP competitors and financial insolvency.
Customers	<ul style="list-style-type: none"> • JD 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 nine percent

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 supplier's work together. There are also another 108 core products making it easy-to-use and the most technologically advanced enterprise applications on the market.

PeopleSoft see that portals are an excellent way to implement new ecommerce 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 lifecycle 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 increase 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 Internet giving customers, employees, and supplier's 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 view 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	<ul style="list-style-type: none"> • The company's real strength lies in providing payroll and human resource solutions to large Australian enterprises and government departments • A genuinely ERP focused company with no specific specialised area. • 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	<ul style="list-style-type: none"> • Currently undefined strategy for e-commerce, B2B and in future directions of systems. • Its manufacturing software has not been as yet readily embraced by Australia industry.

Opportunities	<ul style="list-style-type: none"> • Shift to e-commerce and SME's focus. • Take-up of emerging technologies such as XML. • The buying out of Baan's as well as other ERP customers.
Threats	<ul style="list-style-type: none"> • Other vendors beating them to the punch in the SME, e-commerce and B2B market. • In financial position, compared to Oracle or SAP.
Customers	<ul style="list-style-type: none"> • 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 provide global information access across platforms and across the enterprise. Oracles 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 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 Crireria	Findings
Strengths	<ul style="list-style-type: none"> • 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 or Oracles ERP work is done in house with staff

	being very familiar with the packages.
Weaknesses	<ul style="list-style-type: none"> • Lack of outsourcing or third party consulting means a somewhat inflexible approach to implementation. • Projects have known to be delayed after staff poaching. • A lack of versatile business partners. • Inexperience of migrating large-scale ERP systems to SME's and the current non-existence 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	<ul style="list-style-type: none"> • Monopolise on database products to provide the most reliable and compatible all around ERP system. • Shifting to B2B, e-commerce and e-business solutions for smaller companies.
Threats	<ul style="list-style-type: none"> • Smaller vendors monopolising on the SME territory. • The disagreements between key members of the company with ERP experience.
Customers	Oracles 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, Bann 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 JD Edwards is the only company that provides users with a way of collaborate with other enterprise packages to achieve a business objective.

Flexibility SAP and JD Edwards provide the most flexibility to deal with the changing need 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 JD Edwards in construction and engineering.

ASP SAP and JDEwards 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 JDEwards 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, 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 individual needs of the organization. Bann was suffering from seven consecutive quarters of losses and the lack of market share and financial stability makes it difficult to compete with the others. J.D.Eward 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.Eward 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 databases sales and 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 timeline 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 professional 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 re-sellers 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; 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 percent 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, JDEdwards, 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 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 over time and over budgeted. 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. JD 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 supply 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 different.

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 system 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, onboard 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, 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, 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 are 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.

REFERENCES

Anthony, R. (1970). *Planning and Control Systems: A Framework for Analysis*. New York: John Wiley and Sons.

Avison, D. E. (1992). *Information systems development: a database approach* (2nd ed.). Blackwell Scientific Publications, Oxford [England]; Boston.

Daniels, C. (1994). *Information Technology: The Management Challenge*. Addison-Wesely Publishing Company, USA.

Frenzel, C. (1996). *Management of Information Technology* (2nd ed.), Course Technology, USA

Gome, A. (2000). *Fair trade or foul?* *BRW*, 22, 28, pp91-C94.

Hossain, L. and Shakir, M. (2001). *SIF for understanding the ERP selection in New Zealand*. *Journal of Decision Systems-Special Issue on ERP and Their Impact on Decision Making*, 10. HEREMES Science Publications Paris (In Press).

Kleindl, B. (2000). *Competitive dynamics and new business models for SMEs in the virtual marketplace*. *Journal of Developmental Entrepreneurship*, April (Volume 5, Issue 1), pp73-C85

Kraft, C. L. (1999). *Executive ERP*. *Profit Magazine*, Oracle Publishing

Laudon, K. and Laudon, J. (1998). *Management Information systems: New Approaches to Organisation and Technology*. Macmillan Publishing Co. Ltd. (5th Ed), USA.

Neumann, S. (1994). *Strategic Information Systems: Competition through Information Technologies*. Macmillan College Publishing Company, Inc., USA.

Riemenschneider, C. K., and Mykytyn, P. P., Jr. (2000). *What small business executives have learned about managing information technology*. *Information and Management*, 37, pp257-C269

Rockart, J. (1982). *The Changing Role of the Information Systems Executive: A Critical Success Factors Perspective*. *Sloan Management Review*, Fall, 1-C24.

Rockart, J. and Scott, M. (1984). *Implications of changes in Information Technology for Corporate Strategy*. *Interfaces*, 14, 1, 84-C95.

Stedman, C. and Edwards, J. D. (1999). *ERP Not All in One*. *Computer World*, 33, 21.

OTHER SOURCES

<http://www.oracle.com/>

<http://www.peoplesoft.com/>

<http://www.sap.com/>

<http://www.bannassist.com/>

<http://www.jdedwards.com/>

<http://informationweek.com/752/ntwk.html>

<http://www.erpassist.com/>

http://www.cio.com/archive/051500_fine_content.html

http://www.cio.com/forums/erp/edit/122299_erp_content.html

Webpage

http://www.evtech.com/solutions/app_imp.html

<http://www.ctrcorp.com/ctrcorp/enresplanina.html>

<http://www.informationweek.com/781/erp/htm>

<http://www.informationweek.com/711/11iuerp.htm>

<http://www.britannica.com/bcom/magazine/article/0,5744,258304,00.html>

<http://www.britannica.com/bcom/magazine/article/0,5744,75111,00.html>

<http://www.geocities.com/CollegePark/Library/6045/erp.html>

<http://www.systemerp.co.uk/>

http://www.sun.com.au/service/professional/erp_int.html

APPENDIX 1: PRODUCT FUNCTIONALITY

Product Functionality	SAP	Baan	JDEdwards	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: eg mySAP.com	X				
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 "Cself service, reporting		X	X	X	X
Workflow 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 (workflow)					
Alliances for content and functionality	X	X	X	X	X
EMU compliance CStandards [2]					
Multi-lingual support?				X	
Triangulation [2]					
Training [2, 3]	X				
Computer based training	X	X	X	X	X
Documentation	X	X	X	X	X
Complexity [Unsourced]	X	X	X		X
	SAP	Baan	JDEdwards	PeopleSoft	Oracle
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: eg ODBC					
Product dependence: eg Oracle database					X
Open System [Unsourced]		X	X		X
Evolve with organisation and environment	X	X	X		
Technologically: interoperability	X	X	X		
Economic model: B2B, e-tailing, taxation, regulation	X	X	X	X	X
Suitability [Unsourced]	X	X	X		X
Management Style					
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
Financial position: market share, competition, stability	X				X

APPENDIX 2: 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: eg 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

Workflow automation

[1]

- Business Process Reengineering
- Approval, routing and control automation

Task orientation

[1]

- Support loosely structured activities: centring on single task rather than process (workflow)
- Business Portals
- Alliances for content and functionality

EMU compliance-Standards

[2]

- Multi-lingual support?

Triangulation

[2]

Training

[2, 3]

- Computer based training
- Documentation

Complexity

[Un sourced]

- Not overwhelm SME

- User interface
- Implementation times
- Support required
- Skill level required in staff: use, maintain

No Lock-in to single Vendor

[Un sourced]

- Interoperability
- Alliances, partnerships
- Standards compliance: eg ODBC
- Product dependence: eg Oracle database

Open System

[Un sourced]

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

Suitability

[Un sourced]

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

Geographic Distribution

[Un sourced]

- Support regional offices
- Remote access (web?)
- Regional differences?

Specific Functionality

[Un sourced]

- Data mining
- Data warehousing
- Expert systems: AI, training

- Decision support
- Best-of-Breed

Implementation Strategy

[Un sourced]

Quality of Vendor

[Un sourced]

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

Chapter 14: The SAP Ecosystem;^aA Knowledge Perspective

Greg Timbrell, Guy Gable, Queensland University of Technology, Australia

This paper derives from a parent study titled, Co-operative ERP Lifecycle Knowledge Management (Gable et al., 1998). The central goal of that study is to rationalise knowledge management activities of the three key players involved in ERP lifecycle support; namely the client, the vendor and the implementation partner or consultant. The consultant can play varied roles in a greater or lesser capacity across client ERP installations. It is posited in the parent study that the consultant's role (and the roles of all key players) should be driven by a carefully considered ERP lifecycle-wide knowledge sourcing strategy for the client. Understanding the ERP knowledge marketplace and related dynamics is of clear value to the development of such strategy. In this paper we tentatively explore the concepts of "knowledge-sourcing" and "knowledge strategy friction." We further describe a preliminary attempt to instantiate these concepts through an exploratory, descriptive case study of the "SAP services ecosystem." A broader, related objective of the parent study is to test the power of a "knowledge sourcing world-view" and the integrative potential and explanatory power of such a perspective, with particular emphasis on ERP marketplace dynamics.

INTRODUCTION

This chapter represents a qualitative, descriptive and exploratory case study of the knowledge sourcing activities of consultants in relation to the ERP lifecycle. The context of the study is the SAP "ecosystem." Data collection has primarily involved review of literature, discussions and interviews with practicing ERP consultants, discussion and interviews with vendor representatives from SAP, and reflection on the personal prior consulting experience of the authors with the packaged software marketplace. Much of the literature reviewed were proprietary industry reports (e.g., Gartner Groups, Yankee Group, Delta, etc.) which cannot be cited. Little academic literature specific to the subject under discussion is available.

ERP and the SAP ecosystem

A new class of packaged application software has emerged over the past decade, ostensibly consolidating under a single banner, a multi-billion dollar industry that includes SAP AG, the world's fourth largest software vendor, several other of the largest software firms and the world's largest management consulting organisations. Various called enterprise resource planning systems (ERP), enterprise-wide systems, or simply enterprise systems, these comprehensive, packaged software solutions seek to integrate the complete range of a business's processes and functions in order to present a holistic view of the business from a single information and IT architecture (Gable, Scott & Davenport, 1998; Klaus, Rosemann & Gable, 2000).

A range of influences, have encouraged the increasing uptake of ERP, which already account for a substantial portion of the world-installed base of application software. The world-wide market for enterprise application packages, exclusive of all related hardware and implementation costs, is expected to grow to \$US52 billion by 2002 (AMR Research, 1998).

The term SAP Services Eco-system, first coined by the Gartner Group (1998), refers to the group of firms and professionals worldwide who derive their livelihood from the supply of SAP related products and services. Though discussion on the ecosystem could extend to other important players and relationships (e.g., SAP's hardware partners), the emphasis herein is on systems integration service partners of SAP whom we refer to as "consultants." We place particular emphasis on the large, regional and international consulting firms most often selected as "implementation partner" by ERP clients.

Table 1: Consultants employed on SAP related work

	Americas		Europe		Rest		Total	
	#	%	#	%	#	%	#	%
Large Firms:	9610	41%	10200	43%	3780	16%	23590	66%

Small Firms:	3190	37%	4100	48%	1320	15%	8610	24%
SAP	1300	34%	2000	53%	500	13%	3800	11%
Grand Total:	14100	39%	16300	45%	5600	16%	36000	100%

The table following lists numbers of consultants employed on SAP related work by large (> 900 worldwide) and smaller SAP consulting firms (systems integrators) and SAP as at 1998.

SAP-related work contributes the largest proportion of total revenues for several of the world's major consulting companies. These companies have made substantial investments in their staff (fundamental SAP training for a new consultant costs \$75,000), implementation methods and tools, industry software templates (pre-configured SAP) and related R&D and training facilities. SAP's large implementation partners seek means of enhancing their knowledge management strategies to further leverage their substantial ERP knowledge investment.

ERP Lifecycle Knowledge Management

Where an organisation does not have the requisite knowledge or internal capacity to manage through the "resource spike" caused by initial ERP implementation, it must obtain this knowledge and capacity from external sources. Implementation resources are predominantly knowledge based. This knowledge may be sourced from a consulting firm (knowledge vendor) which acts in the capacity of implementation partner. Among other things, the role of the implementation partner can include project manager, decision-maker, arbitrator and knowledge facilitator.

Having engaged a suitable implementation partner, the client completes the implementation process, goes live with the ERP and moves into the post-implementation maintenance and upgrade cycle. At the end of the implementation phase, the consultant usually withdraws from the organisation. Responsibility for managing the ERP falls back to the client. The continuing success of the ERP is then reliant the client's skill and knowledge in running, supporting, maintaining and upgrading the ERP. In order to keep the ERP "live" and relevant, the client must either draw from their ERP capabilities gained during the implementation period or seek expert support (knowledge) externally. Such external support is usually available from the vendor, the implementation partner and other third parties. This support can be very expensive.

It is proposed in the parent study that the need for post-implementation external support will to a great extent depend on the ERP knowledge transferred and developed during the implementation period. Other factors impacting postimplementation external support requirements might include key staff losses; major upgrades; major configuration changes; and changes to the business process models. The client, therefore, from the very outset needs to carefully consider from where, to what extent, and how they are going to source the knowledge required to ensure the ongoing vitality of their ERP. In other words they need to develop an ERP lifecycle-wide "knowledge sourcing strategy."

The three key players in the SAP ecosystem, the client, the vendor and the implementation partner stand to benefit from effective ERP knowledge management. The vendor, SAP, seeks to redress negative perceptions that SAP implementation duration and cost is difficult to manage and to improve client support and satisfaction. The consulting firms seek to streamline implementation and share in the savings with clients. Both SAP and consultants seek to increase the size of the ERP market through reduced costs and increased benefits to clients. The client will benefit through better-planned lifecycle management and more effective implementation outcomes. Also, to the extent that SAP and its partners can capture key knowledge during implementation, they will be well placed to further support clients throughout the ERP life cycle.

These differing but aligned objectives will drive the separate knowledge strategies of each of the three key players. Zack (1999) defines knowledge strategy, as balancing knowledge-based resources and capabilities with the knowledge required for providing products or services in ways superior to those of competitors. Zack further defines a firm as having an aggressive knowledge strategy when it closely integrates knowledge exploitation and exploration (innovation) using knowledge sources both internal and external to its organisational boundaries. In the SAP services ecosystem, when the business objectives of the three players either compete or overlap there is potential for the players' knowledge strategies to conflict. We call this "knowledge strategy friction." In order to understand knowledge strategy friction, one must examine the knowledge strategy of each player.

CONSULTANTS AND KNOWLEDGE MANAGEMENT

Knowledge Management in Consulting Firms

Knowledge can be tacit or explicit (Polyani, 1958, Nonaka and Takeuchi, 1995). Explicit (or codified) knowledge can be transmitted in formal systematic language, is faster to transfer, thereby providing economic benefits from re-use. Tacit knowledge is more personal, difficult to communicate, rooted in action and experience and resides within the minds of people (Polyani, 1958; Nonaka, 1994). Tacit knowledge is slower to transfer and requires face-to-face or other rich communication mediums. Consulting firms explicate as much implementation experience as possible to provide more efficient implementation experiences for their clients and to improve the retention effectiveness and recall efficiency of their knowledge base.

The consulting sector, and in particular the larger firms, are amongst the most knowledge intensive. Being "knowledge organisations," not surprisingly several of these firms are already highly active in knowledge management. In example, Ernst & Young spends 6% of revenues on knowledge management and measures the amount of knowledge it reuses in the form of proposals, presentations and deliverables and the contributions of its knowledge repository to closing sales (Davenport, 1998). For some large consulting companies, SAP expertise and related knowledge management represents the largest investment they have ever made.

Consulting firms go to great lengths and expense to externalise ERP knowledge in order to achieve a comparative advantage and to leverage their costly people. In the early 90's, Ernst & Young initiated a knowledge strategy whereby it captures and leverages knowledge from consulting engagements. Centres were established to explicate consultants' knowledge into standard methodologies, and to record and refine experiences from consulting assignments (Davenport, 1998).

Price WaterhouseCoopers, KPMG and Arthur Andersen also adopted ERP knowledge explication strategies, using technologies such as Lotus Notes. In addition, tacit knowledge transfer is facilitated through telephone, e-mail access to experienced consultants, and the rise of specialised internal practice networks. This ability to source knowledge quickly within the firm is a basis for the consultants' competitive advantage. Dash (1997 in Im ' Hars, 1998) defined knowledge management as "an attempt to put processes in place that capture and reuse an organisation's knowledge so it can be applied to generate revenue". The generation, codification, transfer and use of ERP implementation knowledge by large consulting firms conform to this particular definition.

Clients pay, not only for access to explicated knowledge, but also for access to the tacit knowledge held by the consultant's staff. Consulting firms attract good people with ERP knowledge away from clients by offering more money and more diverse or challenging experiences that makes them increasingly marketable. This valuable and scarce ERP knowledge can be leveraged across multiple implementations. In a marketplace where demand outstrips supply, it can be uneconomic for a client to retain this knowledge in-house to support a single ERP implementation.

Maister (1993) describes three different types of consulting practices: the expertise practice which employs considerable raw brain power to solve frontier (unique, bleeding edge, new) problems; the experience practice which has dealt with similar situations in previous assignments; and efficiency based firms which can demonstrate established procedures and systems to handle specific problems cost effectively. These three types of practice are not discrete but rather a spectrum along which consulting firms establish various aspects of their practice. Choo (1998) describes the same three types as background knowledge framework, practical know-how and rule-based procedures. The various consulting practices each emphasise differing knowledge management strategies. Two important knowledge services provided by consulting firms when implementing ERP systems are technical product knowledge and product related implementation procedural knowledge (methodologies) i.e., implementation project management.

While expert practices certainly play a role in ERP implementations such as providing zero-based re-engineering services, it is the experience and efficiency type practices that principally conduct ERP implementations. ERP experience, the knowledge of and practised skill in ERP implementations held tacitly by consultants is in short supply.

ERP implementation partners position themselves towards the experience/efficiency end of Maister's spectrum. Efficiency practices have traditionally based their competitive advantage on proprietary implementation methodologies. Clients of these consulting firms realise they must pay a significant premium for these firms' knowledge-base, as it is difficult and costly for consulting firms to capture, externalise and store this knowledge. Clients would not get the same value from capturing and explicating this ERP knowledge themselves because in many cases it would only be used once. If,

however, clients plan to roll out further ERP implementations (e.g., geographically or across divisions), a knowledge retention strategy is worthy of consideration.

How Consultants Store ERP Knowledge

Consultants have sought means of leveraging their knowledge by storing it in "repositories" also call "reservoirs" (Argote & Ingram, 2000) that can be drawn from in future. By storing knowledge, consulting firms can leverage their limited people resources, expedite projects and reduce the negative effects of "knowledge drain."

Four key means by which consultants have sought to store knowledge relating to ERP are: software templates, methodologies, configurable electronic knowledge repositories, and education & training materials (These categories of ERP knowledge store are tentative—further work of the study is aimed at rigorous classification of relevant knowledge stores).

Consultants use several techniques to guide client knowledge sourcing during an ERP implementation. It is important to note that the consulting team "source" the various types of knowledge from their knowledge base of software templates, methodologies, configurable electronic knowledge repositories, and education & training materials. The consultants combine these explicated knowledge stores with their tacitly held experience reserves to guide the client's knowledge sourcing strategy.

Knowledge Sourcing and Consultants

Consulting firms can also be facilitators of clients' ERP knowledge creation and discovery. Their ability to help a firm implement an ERP stems not only from their technical expertise in the ERP system but also their ability to facilitate the client's knowledge sourcing strategy. Consulting firms use techniques such as guided learning, formal training and knowledge creation activities to direct clients to the necessary knowledge required for a successful implementation. This guidance saves the client considerable time and effort in knowledge search costs.

Consulting firms, therefore, must develop a sophisticated knowledge sourcing strategy to support their efforts in facilitating their clients' knowledge sourcing activities in achieving an effective implementation outcome. Not only do they require sophisticated implementation knowledge repositories but also the expertise in applying these repositories to meet their clients' business objectives. To provide perceived value to the client, their knowledge sourcing capability in the ERP implementation knowledge domain must be superior to the client's capability. Consulting organisations employ software templates, methodologies, configurable electronic knowledge repositories, and education & training materials combined with sophisticated internal knowledge management to achieve this superiority.

APPLYING THE CONCEPTS; THE EXAMPLE OF ASAP

With the object of further assessing the robustness and value of a "knowledge sourcing" view of the SAP ecosystem, we now turn to a quite specific development in the ecosystem over the past three years that has had dramatic effect. As previously stated, SAP is concerned about the high cost of implementation and in particular the effect of this high cost as they enter the SME market. ASAP (Accelerated SAP implementation methodology, as of this writing now called ValueSAP) is an internal response to this concern; a concerted effort to make an implementation methodology cheaply available to the marketplace in presumably an attempt to lower the cost of implementation expertise in the SAP marketplace.

While most very large organisations have already adopted ERP world-wide, increasingly small- and medium-sized enterprises (SMEs) too are finding it cost effective and a competitive necessity to follow suit. Marketplace developments, infrastructure technology improvements, and improvements in ERP itself are all encouraging the uptake of ERP by enterprises with revenues of less than \$50 million. Globalisation and electronic commerce require closer integration between large and small enterprises. The availability of powerful microprocessor-based servers; scalable, full-function PC and network operating systems; and low-cost, back-office software make the necessary client/server architectures increasingly affordable.

In response to these developments and having saturated the larger organizations, ERP vendors are making it easier for SMEs to adopt their packages, primarily by simplifying and reducing the costs of implementation. In essence ERP vendors are reducing the amount of knowledge required (to be sourced) by the client. This can be achieved in varying degrees through turning off unneeded functionality, developing largely complete package templates (pre-configuring the software for particular markets or market-niches), turn-key solutions (packaging pre-configured ERP, database, operating system and network software; servers and workstations; and installation and implementation assistance for a fixed price), and outsourcing arrangements such as application service provision (ASP). For a detailed discussion of ERP ASP's see Bennett and Timbrell (2000). In effect the vendors are reducing the knowledge investment required to bring an ERP installation into existence. The ERP vendors are also seeking to influence third-party package software implementation services (consultants) in favor of their desired SME clientele. With implementation costs often far exceeding the costs of the package software and related hardware, it is in implementation that the greatest savings for SMEs are achievable.

ASAP has been embraced enthusiastically by a number of midsize Systems Integrators (SIs). It saves them the continuous investment in a proprietary methodology and gives some of them a short-term marketing advantage. Ce.g., "We finished the first ASAP implementation in the utilities industry in less than 90 days." That the common methodology reduces their differentiation against each other does not appear to bother many of these SIs. However, in spite of their overt support for the concept, ASAP does bother the larger SIs for two reasons. They do not want their differentiation diluted by a common methodology; and even though ASAP is not holistic at this stage, SAP has been encouraging clients to measure SI proposals against an ASAP template. Several SIs have said that SAP is underselling the implementation effort. As with everything, the truth is somewhere in the middle. SAP believes a number of large SIs spend too much time up front doing gap analysis and should, instead, accept that SAP is function-rich and spend the time learning and finding appropriate features within the product. Enterprises that want to implement SAP as is will find ASAP attractive, but they should supplement the product configuration steps the methodology covers with coverage for steps around the software for testing, data migration and other facets (Keller, 1998:42).

DISCUSSION

The advent of ASAP is by itself an extremely interesting development. ASAP embodies or explicates implementation process knowledge. By giving ASAP away along with related education and training, SAP are reducing the value of their implementation partners' investment in proprietary implementation methodologies by providing a strategically equivalent substitute. Consulting firms, therefore must compete by developing and employing alternative core capabilities (see Barney 1991).

Consultants and ASAP

An important question that all consultants and clients must face when developing their ERP knowledge sourcing strategy is "what knowledge should be made explicit and what should remain tacit?" Factors that should influence this decision include:

- The future value of the knowledge;
- Potential (feasibility) of explicating the knowledge;
- Potential for retaining/losing the knowledge once explicated; and
- Cost of explicating the knowledge.

The issue of what knowledge is sourced and how it is sourced by the client organisation (e.g., from consultants or SAP to the client) may often be a question of its form, i.e., tacit knowledge (slow and expensive) or explicated knowledge (cheaper and faster).

In an ERP knowledge management or knowledge sourcing strategy, one must account for the knowledge embodied in software "templates." In example, where a client is starting with vanilla SAP, they must source knowledge of "best practice" business processes. Existing templates embody "explicated" knowledge of a particular industry or niche.

Consultants would appear to have the most to lose from explicating ERP knowledge. The relative rarity of this knowledge is the basis of their (some would say high) economic rent gained from this knowledge. They will be less concerned with transferring their knowledge to clients (as opposed to transferring it directly to the physical system configuration) where they are comfortable that the knowledge will go no further than the client. To the extent that they feel there is risk of the knowledge either becoming 1) public domain, 2) more freely available to other clients, or 3) somehow accruing directly or indirectly to competitors (e.g., other implementation partners or perhaps SAP) - there will be a strong, and understandable reluctance to allow direct access to that knowledge. Also, to the extent it is believed that allowing direct access to the knowledge will cannibalise future services to the client, there again will exist "knowledge strategy friction."

The Consultants' Response

SAP strategies are impacting the options available to their large implementation partners giving rise to knowledge strategy friction. The Big5 and other of the large SIs have been the traditional source of implementation knowledge on ERP projects, and the advent of ASAP has reduced this advantage. Once proprietary knowledge becomes common knowledge its value is reduced. In order to sustain a long-term competitive advantage based on knowledge, the SIs have had to reevaluate their knowledge base/knowledge products. Also, with the passing of the year 2000 and the saturation of large organisations, the large implementation partners, like the ERP vendors, are having to identify other sources of revenue.

The implicit, symbiotic relationship that has existed for several years now between SAP and the SIs, was essentially a Knowledge Supply agreement. The SIs implicitly promoted the supply/sale of SAP knowledge through the promotion of SAP. SAP in return promoted the sale of SI knowledge through the implementations. More recent moves by SAP (alternatively the lack of movement by the Big5) have upset the implicit knowledge supply relationship (SAP's move into services and templates and the giving away of knowledge previously largely proprietary to the Big5. SAP have essentially replicated knowledge previously owned by the SIs, and are now either selling it themselves or giving it away. They are selling it (services, templates) for profit and giving it away (ASAP) to enhance their main product (software) and source of revenue.

Two directions the consulting companies are pursuing today, to some extent motivated by the sorts of threats being posed by SAP, are:

- specialisation/organisation around industries and niche markets, and
- rationalisation of client bases and longer term relationships.

The large implementation partners can no longer market themselves as experts in general ERP implementation processes. Thus, they must find other means of differentiating themselves. Most are moving to develop industry foci, combining related industry expertise with ERP expertise.

The latter strategy may be in direct recognition of the growing importance of the Knowledge Base. Professor Bruce Avolio, Binghamton University, New York, in an interview conducted October 2000, suggested that within the next few years, GALLOP, the premiere American pollster, will become a large and significant international consulting company. He suggested that the two main assets GALLOP possess to make this possible are first, their credibility and perceived objectivity, and second, their massive accumulated knowledge base. Consulting companies [rationalising] their client reservoir may in fact be saying to the clients they keep, that "we want to be your partners in the longer term. We want to work with you to build our knowledge base and we want your commitment to this endeavor. In return, you will have preferential access to the knowledge reservoir."

CONCLUSION

Thus we can see that a "knowledge sourcing" view of the undulating SAP ecosystem is revealing, and can help to explain many of the dynamics being observed. To better manage their ERP lifecycle, clients need to adopt a lifecyclewide knowledge sourcing strategy in order to grow their ERP beyond initial implementation. We have seen that consultants are providers and facilitators of knowledge during the implementation period. They provide technical expertise and also guide the sourcing and knowledge creation activities of the client that results in a working and relevant system.

In order to be competitive in the market and also to sustain their value proposition, consultants need to have both superior technical expertise and superior knowledge sourcing strategies to their clients. The advent of ASAP in the marketplace has altered the knowledge supply agreement and diluted some of the consultants' previous advantage giving rise to knowledge strategy friction. With ASAP the clients have easy access to both declarative and procedural SAP implementation knowledge equal to that of any inexperienced consultant. In Maister's framework, the consultants will have to move towards the experience practice, given that the knowledge underpinning the efficiency practice is now more freely available.

REFERENCES

- AMR Research (1998). *AMR Research Predicts Industrial Enterprise Applications Market Will Reach \$72.6 Billion By 2002*, AMR Research, November, <http://www.amrresearch.com/press/981102.htm>.
- Argote, L. and Ingram, P. (2000). *Knowledge transfer: A basis for competitive advantage in firms*, *Organizational Behavior and Human Decision Process*, 82:1, pp.150-C169.
- Barney, J.B. (1991). *Firm Resources and Sustained Competitive Advantage*, *Journal of Management*, 17, pp.99-C120.
- Bennett, C., and Timbrell, G. (2000). *Application Service Providers: will they succeed?* *Information Systems Frontiers*, 2:2, pp.195-C212.
- Choo, C.W. (1998). *Information Management for the Intelligent Organization*, ASIST Monograph, Information Today, Medford, NJ.
- Davenport, T., and Prusak, L. (1998). *Working Knowledge: how organizations manage what they know*, HBS Press, Boston.
- Gable, G., Scott, J., and Davenport, T. (1998). *Cooperative ERP Life-cycle Knowledge Management, Proceedings of the Ninth Australasian Conference on Information Systems*, 29 September-C2 October, Sydney, Australia, pp.227-C240.
- Gartner Group (1999). *The ERP Vendors Market, Symposium/ITexpo*, 19-22 October, Brisbane, Australia.
- Im, I., and Hars, A. (1998). *Knowledge Reuse-CInsights from Software Reuse, Proceedings of the Nineteenth International Conference on Information Systems*, December 13-C16, Helsinki, Finland.
- Klaus, H., Rosemann, M., and Gable, G. (2000). *What is ERP?*, *Information Systems Frontiers*, 2:2, pp.141-C162.
- Maister, D. (1993). *Managing the Professional Service Firm*, Free Press, New York.
- Nonaka, I. (1994). *A Dynamic Theory of Organizational Knowledge Creation*, *Organisation Science*, 5:1, pp.14-C37.
- Nonaka, I., and Takeuchi, H. (1995). *The Knowledge-Creating Company*, Oxford University Press, New York.
- Polyani, M. (1958). *Personal Knowledge: Towards a Post-critical Philosophy*, University of Chicago Press, Chicago.
- Zack, M. (1999). *Developing a Knowledge Strategy*, *California Management Review*, 41:3, Spring, 1999, pp125-C145.

Chapter 15: A Study of the ERP Selection Process in New Zealand

Maha Shakir, Massey University,
New Zealand
Liaquat Hossain, Syracuse University,
USA

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 the 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 per cent 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 1000 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 (fifteen percent 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)
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 NZ. 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^[1]. 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.

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 & Surveys	No	Yes	Yes
Fixed Price ERP	No	No	Yes
CRM	No	No	Yes
Outsourcing ERP	No	Yes	Yes
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; a 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 the ERP implementation practices from a global perspective. Therefore, a background to the ERP implementation and its context from a global perspective is presented below.

[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."

ERP IMPLEMENTATION AND ITS CONTEXT

ERPs are pre-packaged software applications that integrate information across the entire organization (Davenport, 1998). This integration removes inconsistencies and enables the organization in attaining their consolidated reports. ERP systems are available from vendors such as SAP, Oracle, PeopleSoft, JDEdwards 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):

- i. ERP systems are considered to be standards of business best practice;
- ii. An ERP system includes a set of two or more standard integrated modules, each modelling a certain business process or function;
- iii. Organizations can choose a minimum set of modules to implement and add other modules, as necessary;
- iv. The integration of ERP systems is built within the system removing any inconsistencies of information across an organization; and,
- v. 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 MRPs systems (Chung & Snyder, 1999; Davenport, 2000; Deloitte Consulting LLC, 1999; Kumar & Hillegersberg, 2000; Palaniswamy & Frank, 2000). The MRP families like MRP (materials requirement planning) and MRPII (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 twenty-first 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.

Table 3: The evolution of ERP systems

Systems	Year	Focus	Architecture (Technology)	Users	Level of integration
IC (Customized inventory control software packages)	1960's	Inventory control based on traditional inventory concepts.	2-tier architecture (mainframe)	Plant managers and supervisory staff	No integration
MRP (Material Requirement Planning)	1970's	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)	1980's	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)	1990's	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 multi-site integration
ES, ERP II or ERP of the future (Enterprise Systems)	2000's	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 extraorganizational stakeholders (suppliers, customers, partners)	Integration inside as well as outside the organization

During the late 1990s, the high end of 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 "Inter-organizational" 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 inhouse and acquired or, made partnership 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

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, 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 the 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 a 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 an on the shelf packages that are low in prices 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 SME 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 SME 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 organization 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 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.

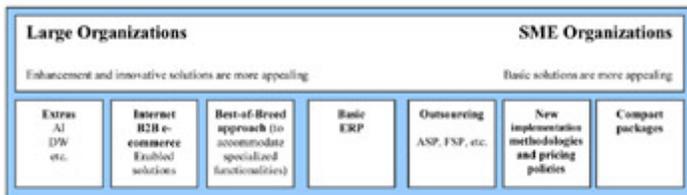


Figure 1: Different ERP strategies for SME and large organizations

ERP systems are offered by five major vendors; SAP, Oracle, PeopleSoft, Baan and JD Edwards. However, there are strengths-weakness- opportunity-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 six-column matrix where the five right columns include vendors' data while the sixth 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 products offering, and services, partnerships and community involvement. These four dimension are illustrated in table 4-a, table 4-b, table 4-c, and table 4-d, respectively. The second section of table 4 (which is numbered 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 become obsolete very quickly.

Table 4 (Part 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 organisation					
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 world-wide	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 world-wide)
Countries	Not available	100 countries (48 offices)	76	Not available	more than 110 countries
Languages	Not available	21	29	Not available	28 languages
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 I's," which represent Innovation, Integrity and Initiative.	The Company attributes much of its success to a corporate culture that emphasise Solutions, Relationships, and Value. The Company is committed to technical quality in the forms of ISO 9000 certification and support for the Malcolm Baldrige principles. J.D. Edwards' commitment to product quality, its corporate culture and a customer-centric, value-based approach enables 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 (Part 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 organisation 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 centralised 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 in than 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 multi-national organisations 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, personalised 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 (Part 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, pre-tested as an industry specific solution.	Not available	A family of solutions specifically designed for midsized 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 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 includes: SAP Business Information Warehouse™ and SAP Strategic Enterprise Management™

Table 4 (Part 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 organisations 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 four 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 world-wide.	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 customisation 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 non-profit agencies and schools), Oracle's Promise (providing computers to public schools in low-income neighbourhoods) and Sponsoring the Special Olympics	PeopleSoft takes great pride in serving communities where employees work and live. Community include: charitable contributions, volunteering, giving guidelines, proposal process and computer/product donations	Not available

Table 4 (Part E): A SWOT analysis of the different ERP systems offered by the top five vendors

SWOT	Baan	J.D. Edwards	Oracle	PeopleSoft	SAP
Strengths	<u>Expertise:</u> manufacturing knowledge. <u>Market share:</u> target market Favours SME which is expected to be the future area of growth for ERP	<u>Expertise:</u> specialised offering such as construction, engineering, etc.	<u>CRM:</u> 1 st to include CRM as part of the ERP product. <u>Databases (DB):</u> World leader in DB sales. <u>E-Commerce:</u> 1 st to offer Internet capability to the ERP product. <u>Expertise:</u> Financial applications. <u>Financial results:</u> The best of the top 5 vendors. <u>Implementations:</u> Managed by the vendor.	<u>Expertise:</u> Human resources.	<u>Customers:</u> Largest customer base <u>Customisation:</u> More options <u>Expertise:</u> manufacturing knowledge <u>Market share:</u> Market leader <u>Partnerships:</u> Partnerships with all the big five consulting firms, hardware vendors, ASPs, AIs and universities. <u>Research and development:</u> highest research and development expenditure plus the university alliance program.
Weaknesses	<u>Financial results:</u> The worst of the top 5 vendors.	<u>CRM:</u> No CRM product developed internally.		<u>CRM:</u> No CRM product developed internally but recently acquired a CRM vendor.	<u>Clients' satisfaction:</u> disgruntled clients as "up to 30 percent of all SAP implementations fail to meet the buyer's expectations," (Girard & Farmer, 1999) <u>Complexity:</u> is high. Need more time and resources to configure. <u>Price:</u> Expensive <u>Resources required to implement:</u> Time and resource consuming. <u>Specialisation:</u> Focus is on the core ERP modules.
Opportunities	<u>E-commerce Implementation methodology Outsourcing</u>	<u>E-commerce Implementation methodology</u>	<u>Compact packages E-commerce Implementation methodology Outsourcing</u>	<u>E-commerce Implementation methodology</u>	<u>E-commerce Implementation methodology Outsourcing</u>

Threats	Competition: from large as well as small vendors.	Best-of-breed offerings: Specialised solution:	Best-of-breed offerings: Specialised solution:	Law suits: Best-of-breed offerings: Specialised solution:	Law suits: for failed implementations. Best-of-breed offerings: Picking the best and integrating. Specialised solution: especially by small and startup competitors.
---------	---	--	--	---	--

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 world-wide. 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 perceived and still is 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 percent 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 are web-enabled and e-commerce applications which 23 percent of the companies surveyed planned to dedicate funding to. Table 4-c, illustrates the new ERP product offering presented earlier in Figure 1, while Table 4-d provides background information on services, partnerships and community involvement of the five vendors.

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 databases (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 JDEdwards 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 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 system 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 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;^atop management, users, and IS personnel;^aare 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 four fold. 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 summary of the tasks of internal stakeholders involved in the selection of ERP systems

Internal Stakeholders	Tasks in selecting ERP
Top Management	<ol style="list-style-type: none"> 1. to set organisation-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 tem; and, 4. to set up a mechanism to review regularly the effectiveness of current activities, specifying objectives and establishing procedure to ensure adequate communication within the enterprise.
Uses	<ol style="list-style-type: none"> 1. to ensure that user requirements are met, to gain user commitment and to avoid user resistance; 2. to take active participation 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	<ol style="list-style-type: none"> 1. to provide necessary assistance to help top management and users solve related problems; 2. to recruit and provide opportunities for career development networking professional; and, 3. to develop understanding of the overall business operations.

Educating top management on the role of IS and its contribution as well as the 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

organisational 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 user 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, 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 recommendation, 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 policy, project priorities, project objective, and selection criteria is passed from top management to users. Furthermore, information regarding budget policy, 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 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 JD Edwards. The interview lasted between forty-five 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 ten and fifteen 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.

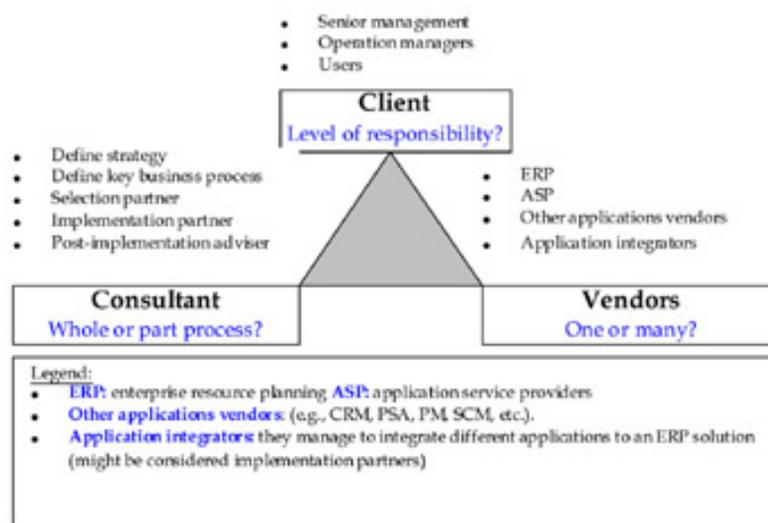


Figure 2: Stakeholders involved in the selection and implementation of ERP

Interview findings suggest that client 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, discussion with clients to identify the key business processes (KBPs), and providing 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 the 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 increases 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.

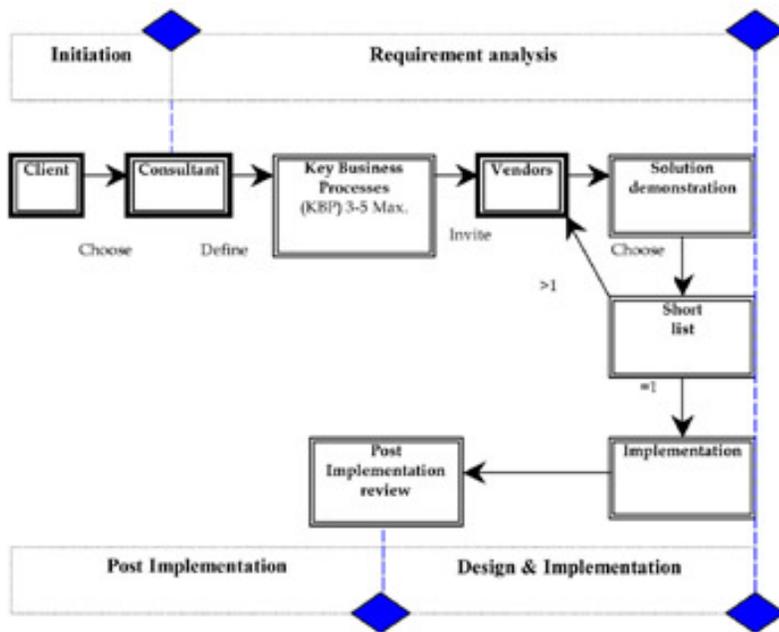


Figure 3: A generic model of the ERP selection process in New Zealand (Shakir, 2000)

CONCLUSIONS

New Zealand findings suggest that the ERP selection process is different from 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 the 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 and as well as the post-implementation costs involved in the maintenance of a system is encouraging Small-to-Medium sized organisations 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 insourcing 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.

REFERENCES

Bell, S. (1999, 29 March). *Outsourcing ERP*. *Computerworld New Zealand* 17.

Brancheau, J. C., Janz, B. D., & Wetherbe, J. C. (1996). *Key Issues in Information Management: 1994-C95 SIM Delphi Results*. Available: <http://www.colorado.edu/omfs/jch/key/us90sum.html>.

Brookes, C. H. P., Grouse, P. J., Jeffery, D. R., & Lawrence, M. J. (1982). *Information Systems Design*.: Prentice Hall.

Cavaye, A. L. M. (1995). *User Participation in System Development Revisited*. *Information and Management*, 28, 311-C323.

Choe, J. M. (1996). *The Relationships among Performance of Information Systems, Influence Factors, and Evolution Level of Information Systems*. *Journal of Management Information System*, 12(4), 215-C239.

Choe, J. M., & Lee, J. (1993). *Factors Affecting Relationships between the Contextual Variable and the Information Characteristics of Information Systems*. *Information Processing and Management*, 29(4), 471-C486.

Chung, S. H., & Snyder, C. A. (1999). *ERP Initiation: A Historical Perspective*. Paper presented at the Americas Conference on Information System (AMCIS), Milwaukee.

Davenport, T. H. (1998). *Putting the Enterprise Into The Enterprise System*. *Harvard Business Review*, July/August, 121-C131.

Davenport, T. H. (2000). *Mission Critical: Realizing the Promise of Enterprise Systems*. Boston, Massachusetts: Harvard Business School Press.

Deloitte Consulting LLC. (1999). *ERP's Second Wave: Maximizing the Value of Enterprise Applications and Processes*. Available: <http://www.dc.com/services/secondwave> [2000, May 16].

Enzweiler.Group. (1999). *Links to ERP Systems Information*. Enzweiler Group, Atlanta, GA,. Available: <http://www.enzweiler.com/links.html>.

Girard, K., & Farmer, M. A. (1999, 3 November). *Business Software Firms Sued Over Implementation*. <http://cnetnews.com/>. Available: <http://news.cnet.com/category/0-1008-200-1428800.html> [2000, May].

Hammer, M. (2001). *The Superefficient Company*. *Harvard Business Review*, September, 82-C91.

Janzen, W. (1999). *How ERP and E-technology Will Merge*.: ERP NewsLetter.

Konicki, S. (2000, 8 May). *Analysts Unimpressed With SAP-Clarify Deal*. Available: <http://www.crmsupersite.com/NL/NL-20000512-iworld.htm> [2000, May].

Kumar, K., & Hillegersberg, J. v. (2000). *ERP Experience and Evolution*. *Communications of the ACM*, 43(4), 23-C26.

Markus, M. L., & Tanis, C. (2000). *The Enterprise Systems Experience-From Adoption to Success*. In R. W. Zmud (Ed.), *Framing the Domains of IT Research: Glimpsing the Future Through the Past* (pp. 173-C207). Cincinnati, OH: Pinnaflex Educational Resources, Inc.

Mills, K. (1999, 29 March). *Small Companies to ERP Vendors: Try Harder*. *Computerworld New Zealand*, 6.

Palaniswamy, R., & Frank, T. (2000). *Enhancing manufacturing performance with ERP systems*. *Information Systems Management*, 17(3), 43-C55.

Palvia, P. C., Rajagopalan, B., Kumar, A., & Kumar, N. (1996). *Key Information Systems Issues: An Analysis of MIS Publications*. *Information Processing and Management*, 32(3), 345-C355.

Palvia, P. C., Zigli, R., & Palvia, S. (Eds.). (1992). *Global Information Technology Environment: Key MIS Issues in Advanced and Less-Advanced Nations*. IDEA Group Publishing.

Perry, A. (1999, 26 September). *It May Be Late But MySAP.com Blossoms into Life*. *NZ Info Tech Weekly*, 6.

Pullar-Strecker, T. (1999, Issue Date). *QSP Targets Web with New Business Consultancy Division*. *NZ Infotech Weekly*, pp. 8.

Ross, J. (1999, July-August). *Surprising Facts about Implementing ERP*. *IT Professional*, 65-C68.

Ross, J. W., & Vitale, M. R. (2000). *The ERP Revolution, Surviving vs. Thriving*. *Information Systems Frontiers*; special issue of on *The Future of Enterprise Resource Planning Systems*, 2(2), 233-C241.

Scannell, E., Nelson, M., & Briody, D. (1999, 12 November). *Budgets in 2000 earmarked for ERP, CRM, e-commerce*. *InfoWorld Electric*. Available: <http://www.infoworld.com/cgi-bin/displayStory.pl?991112.hnbudget.htm> [2000, June].

Shakir, M. (2000). *Decision Making in the Evaluation, Selection and Implementation of ERP Systems*. Paper presented at the Americas Conference on Information Systems, Long Beach, California.

Thong, J. Y. L., Yap, C. S., and Raman, K. S. (1996). *Top Management Support, External Expertise and Information Systems Implementation in Small Business*. *Information Systems Research*, 7(2), 248-C267.

Wells, A. (1999, Issue Date). *Survey Shows ERP j@beyond reachj~ of Many NZ Businesses*. *NZ Infotech Weekly*, pp. 7.

Chapter 16: Beyond ERP Systems as a Hype;^a Understanding ERP Systems as Distinct Technological, Organizational and Cognitive Phenomena

Eveline van Stijn, University of Twente,
The Netherlands

This conceptual chapter addresses the question why research on ERP systems makes sense. Its purpose is to show that ERP systems are not simply hype or buzz. This chapter adopts the view that ERP systems are technological, organizational, and cognitive in nature. Along those dimensions, ERP systems can be distinguished from other IS, while also identifying similarities. Future research may concern the proposed characteristics of those dimensions and may also relate to their interactions and interrelations. Questions for investigation are presented throughout the paper. Further research promises to extend academic understanding of ERP systems, as a specific domain of IS. As a result, business practice can be supported to actually realize benefits with their ERP systems.

INTRODUCTION

Some scholars classify Enterprise Resource Planning (ERP) systems in the category of "buzzwords," probably together with other contemporary IS terms as customer relationship management, data warehouses, and knowledge management systems (Swanson, 2000). Moreover, ERP vendors start selling extended-ERP solutions that might as well include all those IS. The academic concern for ERP Systems as a Hype ERP systems, in teaching and research, is increasing. But caution is advised! "[i-] Empirical researchers should not confuse the current buzz about information systems with the existing population of systems deserving of study. Perhaps much too frequently for their own good, empirical researchers seem to be attracted to the "latest and the greatest" just like everyone else. They plunge in to make observations of scattered and ill-understood phenomena still under substantial development and change, coming too often to findings destined to evaporate in their relevance much too soon. They tend to ignore that which has become widespread, well established and even mundane, and therefore fail to make the more obvious observations and draw the needed longer-term, underlying lessons for us (Swanson, 2000, p. 925)."

Did we all plunge in the ERP hype or are ERP systems really worthwhile studying? Some publications illustrate a plunge, specifically when they indeed appear to forget the rigorous body of relevant scientific literature. Fortunately, other papers support the point that "like this paper purports to demonstrate," ERP research is valuable for science and practice. This paper proposes to describe ERP systems along three dimensions, namely technological, organizational, and cognitive. After a methodological note, they are discussed along these three dimensions. Throughout the paper, questions for further inquiry are presented. Based on the understanding of ERP systems as distinct three-dimensional phenomena, the conclusion is drawn why ERP research is appealing.

A METHODOLOGICAL NOTE

Information systems are generally characterized as being technological and organizational in nature. Many different information technologies are available to organizations. Self-evidently, when applied in organizations, a diversity of organizational aspects is important too, for instance regarding task-technology fit (Zigurs and Buckland, 1998) or organizational change in the context of IT (Robey and Boudreau, 1999). A third^aless commonly recognized^adimension is the cognitive dimension. Obviously, cognitive elements such as knowledge and information, are also important in the context of IS. Structuration theory of IT (Orlikowski and Robey, 1991; DeSanctis and Poole, 1994) and organizational memory theory (Walsh and Ungson, 1991; Stein and Zwass, 1995) both explicitly address this dimension. Cognitive issues may relate for instance to organizational learning during IS development and implementation (Robey et al., 1995; Salaway, 1987; Stein and Vandenbosch, 1996).

In order to compare and distinguish ERP systems from other IS, such as workflow management systems and e-commerce systems, they are characterized along those three dimensions. Based on 20 descriptions of ERP systems (used references marked with *) complemented with other ERP and (IS) literature, several general IS characteristics have been identified for each dimension. For instance, ERP systems are believed to highly integrate organizational processes, which can be derived to the characteristic "organizational integration." Groupware may also score high on organizational integration, whereas an e-commerce system may score low. The technological dimension is discussed next.

ERP'S TECHNOLOGICAL DIMENSION

Five general IS characteristics may be distilled for the technological dimension and filled out for ERP, namely development, applied technologies, complexity, standardization, and integration.

1. Development

ERP systems are commercial packages from third-party suppliers. Currently, key suppliers are SAP AG, Baan, J.D. Edwards, PeopleSoft and Oracle. ERP systems can be understood as semi-finished products with tables and parameters to be configured in-house (Shang and Seddon, 2000). The organization may customize the ERP software by means of add-ons or other enhancements (Markus and Tanis, 2000; Keller and Teufel, 1998). Yet unanswered questions are how to decide what aspects of the ERP package need to be enhanced (to better fit the organization's needs), how, and under which conditions?

2. Applied technologies

ERP systems consist of multiple technologies such as client-server systems and web-technology with specific features, such as being real-time, online, and interactive (Brown et al., 2000; Madani, 2000). The application of multiple technologies is assumed to lead to specific concerns regarding complexity, standardization and integration, characteristics discussed next.

3. Complexity

Because of their large scale and organization-wide scope, ERP systems are considered to be highly complex. One may distinguish component complexity, coordinative complexity, and dynamic complexity (Banker et al., 1998). "[i-] Component complexity refers to the number of distinct information cues that must be processed in the performance of a task, while coordinative complexity describes the form, strength, and interdependencies of the relationships between the information cues. Dynamic complexity arises from changes in the relationships between information cues over time, particularly during task performance (Banker et al., 1998, p. 435)." In these terms, complexity of ERP has not been investigated yet, nor the potential effects. Hypothetically, high complexity may for instance negatively influence the implementation process.

4. Standardization

ERP systems are developed largely out-house, and considered to be prewritten and of a generalized nature. The level of standardization^astriven for by means of reference business process models supplied by ERP vendors and consultants (Keller and Teufel, 1998; Scheer, 1998)ⁱappears to be high. The reference business process models should make technological realization easier. However, suppliers have tended to develop non-open systems, while standardization across packages did not take place (Loos, 2000). That may decrease ERP's flexibility, obviously an important requirement. Further componentization and standardization of interfaces are two solutions currently adapted to enhance flexibility (Loos, 2000; Sprott, 2000).

5. Technological integration

One may distinguish different forms of technological integration, for instance relating to the hardware architecture, components, data, and other IT. With respect to all those forms, ERP systems are regarded highly integrated. Take for example the SAP Strategic Enterprise Management (Meier et al., 2000). For vertical integration of business news, data are obtained from Internet, processed applying text mining, coupled to internal data from the ERP system, and provided to the managers. Researchers can help to develop such technologically integrated solutions and investigate problems that may occur. How reliable are for instance the text mining procedures? Do they filter the data in such a way that the information needs are fulfilled?

Next, ERP's organizational dimension is discussed, including organizational integration.

ERP'S ORGANIZATIONAL DIMENSION

The following three IS characteristics are distinguished: functionality, effectiveness orientation, and organizational integration.

1. Functionality

The ERP system allegedly supports many business processes, varying from human resource management to logistics (Davenport, 1998). Some functions of SAP R/3 (Table 1) illustrate this.

Originally, ERP systems concentrated on those internal organizational processes. Currently, ERP systems evolve into extended-ERP, incorporating inter-organizational processes as e-business, and supply chain management (Kumar and Van Hilleberg, 2000). The mentioned description of ERP functionality may fail to catch the "spirit" of ERP systems, and might as well be outdated next week. Perhaps one of the pitfalls of studying a buzzword phenomenon?

Table 1: Functionality of SAP R/3 (SAP, 2000)

R/3 Financial	R/3 Human resources	R/3 Logistics
<ul style="list-style-type: none"> • Financial Accounting 	<ul style="list-style-type: none"> • Personnel Management • Organizational Management 	<ul style="list-style-type: none"> • Product Data management
<ul style="list-style-type: none"> • Controlling 		<ul style="list-style-type: none"> • Sales and distribution • Production planning and control
<ul style="list-style-type: none"> • Joint Venture Accounting 	<ul style="list-style-type: none"> • Personnel Administration • Recruitment • Personnel Development • Training and Event Management 	<ul style="list-style-type: none"> • Project system
<ul style="list-style-type: none"> • Investment Management 		<ul style="list-style-type: none"> • Materials management • Quality management
<ul style="list-style-type: none"> • Corporate Real Estate Management 	<ul style="list-style-type: none"> • Compensation Management • Benefits Administration • Personnel Cost Planning 	<ul style="list-style-type: none"> • Plant maintenance • Service management
<ul style="list-style-type: none"> • Enterprise Controlling 	<ul style="list-style-type: none"> • Time Management • Payroll Accounting 	
<ul style="list-style-type: none"> • Treasury 	<ul style="list-style-type: none"> • Travel Management 	

2. Effectiveness orientation

It is proposed here to use the concept of "effectiveness orientation" to capture what ERP systems are about. The "effectiveness orientation" is based on the framework by Quinn and Rohrbaugh (1983) - comprises of two dimensions, namely focus (internal/external) and structure (flexibility/control). It is proposed to exclude the mentioned added functionality from the ERP system. Instead, ERP is understood here as concentrating on control of resources and activities *within* the organization. Registering, planning, tracking, standardizing, optimizing, and performance measurement are all control functions embedded in ERP systems. It is yet unclear to what extent ERP systems contribute to enhanced performance, and under which conditions. May for instance the control focus inhibit overall effectiveness improvement?

3. Organizational integration

Organizational integration may be defined as "[i-] the action of forming an ensemble, a coherent whole, of the various administrative units that make up the enterprise, each of which assumes certain functions (Alstine, 1999, p. 27)." The organization may be interpreted as a collection of parts or subsystems (Katz and Kahn, 1966; Senge, 1990). One of the issues relating to ERP integration, then, is the definition of an organization in terms of interrelated subsystems. It is the question which aspects of the organization

are dependent in what way and to what extent. Highly related aspects may be tighter integrated, while low interdependence can lead to very loosely coupling (Weick, 1969). How can organizations integrate their ERP-related internal processes? Some organizations choose not to implement full ERP functionality, but for instance only implement human resource management and financial accounting components. In fact, they are not realizing an enterprise-wide system, or the proposed enterprise-wide integration. What does this mean in terms of such organizations' realization of ERP benefits? Do other ERP problems originate here as well?

The third dimension, addressed next, is the cognitive dimension.

THE COGNITIVE DIMENSION OF ERP

Five cognitive IS characteristics are distinguished, namely information, skills, knowledge, and paradigms, and cognitive integration.

1. Information

"[i-] Information is the flow of messages, while knowledge is created and organized by the very flow of information, anchored on the commitment and belief of its holder (Nonaka, 1994, p. 15)." Information can be seen as messages that can become knowledge when its receivers can interpret these messages. Though data may be interpreted as being cognitive as well, it is proposed here to regard data as technological in nature, being the stored bits and bytes that may become information. ERP information focuses on the functional domains, such as logistics and finance (see Table 1).

2. Paradigms

Paradigms refer to the organizational beliefs and the reigning values and norms about i@what is good and what is bad_i, what one should and should not do (Kuhn, 1970). A key premise is that ERP systems embody best practices in their reference models (Davenport, 1998; Kumar and Van Hillegersberg, 2000), which allegedly leads to improved effectiveness. Reference models are based on theoretical and practical best practice assumptions (beliefs) for a given process. But processes exist within a rich context, including products and services, customers, suppliers, and employees (Van Stijn and Wensley, 2001). In which context do reference models apply?

3. Knowledge

Knowledge, or interpretive schemes, can be described as "[i-] a mental template that individuals impose on an information environment to give it form and meaning (Walsh, 1995, p. 281)." Knowledge helps human actors to give the world meaning (Orlikowski and Robey, 1991). Process knowledge, both companyspecific and general, is embedded in the ERP system. Procedural knowledge, such as economic controlling, logistics and sales procedures are programmed into the ERP system (Koch, 2000).

4. Skills

Skills are comparable to tacit (Nonaka, 1994) or soft knowledge (Anand et al., 1998), capabilities "how things are done." Usually, those capabilities have a personal quality, deeply rooted in action, commitment, and involvement (Nonaka, 1994). Skills may be elicited for the ERP in the form of routines or decision models, or in the form of a skill database in the HRM component of the ERP system, linking employees and skills.

5. Cognitive integration

Cognitive integration means integration of the above characteristic "contents" of the ERP system. Integration may provide the organization with a comprehensive holistic view of the business (Gable and Rosemann, 2000), but it may also pose difficulties. Though crucial when considering that organizational effectiveness will be "[i-] a function of the degree to which decision-makers have knowledge about the nature of these interdependencies (Duncan and Weiss, 1979, p. 83)," it may be very difficult to understand the organization as a whole. It should be noted that although integration is important, it should not become a goal in itself.

Table 2: Summary of the proposed dimensions and characteristics.

Technological	Organizational	Cognitive
Development	Functionality	Information
Applied technologies	Effectiveness orientation	Paradigms
Complexity	Organizational integration	Knowledge

Standardization		Skills
Technological integration		Cognitive integration

DISCUSSION

The basic premise is that, like any IS, the purpose of ERP systems is to support the organizational processes in order to enhance effectiveness. Effectiveness is a complex and controversial organizational construct. One could say that effectiveness means that the organization functions in such a way that it has a relative sustained competitive advantage over its competitors (Hamel and Prahalad, 1994; Kettinger et al., 1994). Such effectiveness, or performance, is dependent on how the organizational processes function. The design of those processes may be dependent on what is introduced here as the effectiveness orientation. ERP systems focus on control and internal processes. The latter characterization of ERP appears to counter the current trend of extended functionality and may appear to be rather artificial in this respect. However, for research purposes, because it makes it possible to study ERP systems within its borders, as well as its relations and interactions beyond. Illustratively, one could study ERP in relation to manufacturing and project planning (see [Table 1](#)), or investigate the impact of ebusiness on ERP.

The discussed characteristics of ERP systems may be used as potential metrics for studies of ERP success, that is currently ranging from drastic failure to extreme success (Boudreau and Robey, 1999). Though potential ERP benefits have been identified (Shang and Seddon, 2000), research on evaluation is scarce (Rosemann and Wiese, 1999). To what extent are benefits actually realized? How do identified critical success factors (Holland et al., 1999), such as top management commitment, attribute to these results? Allegedly, the integration of internal processes and the use of best practices are important factors contributing to the ERP system's success. Are they? What if cognitive contents the third party developing the ERP system had in mind are different than the actual knowledge of the organization that is implementing or using the ERP system? Such conflicting cognition (or organizational memory mismatches), may disable the organization to realize ERP benefits (Van Stijn and Wijnhoven, 2000). What other influences does such conflicting knowledge have? And how can organizations (and researchers!) deal with the tacit nature of much of this contextual knowledge? Tacit knowledge is particularly difficult to formalize and communicate (Nonaka, 1994). What difficulties does that pose on diagnosis and coping?

Like integration, one may consider complexity and standardization crossdimensional characteristics too. ERP business process models intend to standardize the various cognitive elements. Furthermore, the organization may adapt its organizational processes to standard business process models, thus leading to organizational standardization. Organizational complexity with respect to an ERP system may be very high, since the system relates to many different organizational functions and processes. Complexity with respect to the cognitive elements may also be very high. For instance, in the context of experts systems, knowledge complexity has been defined as "[i-] the degree of depth and specialization of the internalized knowledge of human experts, the scope of the decision-making process, and the level of expertise required, including discipline-based knowledge, that is incorporated into the expert system application (Meyer and Curley, 1991, p. 456)." High technological, organizational, and cognitive complexity may cause the adoption of ERP systems to be more difficult than of low complexity IS, potentially causing ERP implementations to take much more time (and money) (Bingi et al., 1998). High complexity may also be hypothesized to make it difficult to realize benefits, as opposed to benefiting from low complexity IS.

CONCLUSION

Did we all plunge in the ERP hype or are ERP systems really worthwhile studying? This paper aimed to demonstrate that ERP system research is meaningful. The paper described ERP systems along the technological, organizational, and cognitive dimension, and proposed several general characteristics for each. Understanding them as three dimensional phenomena makes it clear that ERP systems exhibit a combination of specific characteristics that makes them distinct from other information systems that share some, but by no means all, of those characteristics. ERP is a distinct IS domain. A myriad of potential research questions have been posed and, clearly, many more issues may be identified. Considering that the proposed characteristics may be used as potential metrics for studies of ERP success, it is my contention that organizations may profit from future ERP research that aims to enhance our understanding of how to realize benefits with ERP systems. As long as we do not forget the rich body of IS and other scientific knowledge, and engage in high quality research, it's a challenge to conduct ERP research.

ACKNOWLEDGEMENTS

The author wishes to thank her colleagues Diana Limburg and Fons Wijnhoven, and the anonymous reviewers, for their constructive comments on previous versions.

REFERENCES

- Alsina, É. (1999). *The computer integration of the enterprise*. *IEEE transactions on engineering management*, 46(1), 26-35.
- Banker, R. D., Davis, G. B. and Slaughter, S. A. (1998). *Software development practices, software complexity, and software maintenance performance: A field study*. *Management Science*, 44(4), 433-450.
- Bingi, P., Sharma, M. K. and Godla, J. K. (1998). *Critical issues affecting an ERP implementation*. *Information Systems Management*, 16(5), 7-14.
- Brown, C. V., Vessey, I. and Powell, A. (2000). *The ERP purchase decision: Influential business and IT factors*. *AMCIS2000*, 1029-1032.
- Davenport, T. H. (1998). *Putting the enterprise into the enterprise system*. *Harvard Business Review*, July-August, 104-112.
- DeSanctis, G. and Poole, M. S. (1994). *Capturing the complexity in advanced technology use: Adaptive structuration theory*. *Organization Science*, 5(2), 121-147.
- Duncan, R. B. and Weiss, A. (1979). *Organizational learning: implications for organizational design*. *Research in Organizational Behavior*, (1), 75-123.
- Gable, G. G. and Rosemann, M. ERP in university teaching and research. 2000
- Haines, M. N. and Goodhue, D. L. (2000). *ERP implementations: The role of implementation partners and knowledge transfer*. *IRMA2000*, 34-38.
- Hamel, G. and Prahalad, C. K. (1994). *Competing for the future* Boston, MA: Harvard Business School Press.
- Hedman, J. (2000). *The CES framework for discussing ES*. *AMCIS2000*, 649-654.
- Holland, C. P., Light, B. and Gibson, N. (1999). *A critical success factors model for enterprise resource planning implementation*. *ECIS99*, 273-287.
- Katz, D. and Kahn, R. L. (1966). *The Social Psychology of Organizations*. New York: John Wiley & Sons.
- Kettinger, W. J., Grover, V., Guha, S. and Segars, A. H. (1994). *Strategic information systems revisited: A study in sustainability and performance*. *MIS Quarterly*, 18(1), 31-58.
- Kirchmer, M. (1999). *Business Process-Oriented Implementation of Standard Software: How to Achieve Competitive Advantage Efficiently and Effectively*. Berlin: Springer.
- Koch, C. (2000). *Building coalitions in an era of technological change*. *Journal of Organizational Change Management*, 13(3), 275-288.
- Kremers, M. and Van Dissel, H. (2000). *ERP system migrations*. *Communications of the ACM*, 43(4), 53-55.
- Kuhn, T. (1970). *The Structure of Scientific Revolution* (second edition). Chicago, IL: University of Chicago Press.
- Kumar, K. and Van Hillegersberg, J. (2000). *ERP experiences and evolution* *Communications of the ACM*, 43(4), 23-26

- Lee, Z., Lee, J. and Sieber, T. (2000). *ERP-based knowledge transfer*. *IRMA2000*, 865-C867.
- Loos, P. (2000). *Advanced information technology application in ERP systems*. *AMCIS2000*, 635-C639.
- Madani, H. H. (2000). *Re-engineering the role of the internal auditor in ERP solutions*. *IRMA2000*, 103-C105.
- Markus, M. L. and Tanis, C. (2000). *The enterprise systems experience* From adoption to success In Zmud, R.W. (Ed.), *Framing the Domains of IT Research: Glimpsing the Future through the Past*, 173-C207. Cincinnati, OH: Pinnaflex Educational resources, Inc.
- Markus, M. L., Tanis, C. and Van Fenema, P. C. (2000). *Multisite ERP implementations*. *Communications of the ACM*, 43(4), 42-C46.
- Meier, M., Filleborn, A. and Mertens, P. (2000). *Vertical integration of business news from the Internet within the scope of SAP strategic enterprise management (SAP SEM)TM*. *AMCIS2000*, 663-C668.
- Nonaka, I. (1994). *A dynamic theory of organizational knowledge creation*. *Organization Science*, 5(1), 14-C37.
- Oliver, D. and Romm, C. (2000). *ERP systems: the route to adoption*. *AMCIS2000*, 1039-C1044.
- Orlikowski, W. J. and Robey, D. (1991). *Information technology and the structuring of organizations*. *Information Systems Research*, 2(2), 143-C169.
- Quinn, R. E. and Rohrbaugh, J. (1983). *A spatial model of effectiveness criteria: Towards a competing values approach to organizational analysis*. *Management Science*, 29(3), 363-C377.
- Rao, S. S. (2000). *Enterprise resource planning: Business needs and technologies*. *Industrial Management and Data Systems*, 100(2), 81-C88.
- Rizzi, A. and Zamboni, R. (1999). *Efficiency improvement in manual warehouses through ERP systems implementation and redesign of the logistics processes*. *Logistics Information Management*, 12(5), 367-C377.
- Robey, D. and Boudreau, M. C. (1999). *Accounting for the contradictory organizational consequences of information technology: Theoretical directions and methodological implications*. *Information Systems Research*, 10(2), 167-C185.
- Robey, D., Wishart, N. A. and Rodriguez-Diaz, A. G. (1995). *Merging the metaphors for organizational improvement: Business process reengineering as a component of organizational learning*. *Accounting, Management & Information Technologies*, 5(1), 23-C40.
- Rosemann, M. and Wiese, J. (1999). *Measuring the performance of ERP software: A balanced scorecard approach*. *Proceedings of the 10th Australasian Conference on Information Systems*.
- Salaway, G. (1987). *An organizational learning approach to information systems development*. *MIS Quarterly*, 11(2), 245-C264.
- SAP. (2000). <http://www.sap.com/>, January.
- Scheer, A.W. (1998). *ARIS Business Process Frameworks* (second edition). Berlin: Springer.
- Senge, P. M. (1990). *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York: Doubleday/Currency.
- Shakir, M. (2000). *Decision making in the evaluation, selection, and implementation of ERP*

systems. *AMCIS2000*, 1033-C1038.

Shang, S. and Seddon, P. B. (2000). *A comprehensive framework for classifying the benefits of ERP systems. AMCIS2000*, 1005-C1014.

Soh, C., Kien, S. S. and Tay-Yap, J. (2000). *Cultural fits and misfits: Is ERP a universal solution? Communications of the ACM*, 43(4), 47-C51.

Somers, T. M., Nelson, K. and Ragowsky, A. (2000). *Enterprise resource planning (ERP) for the next millennium. AMCIS2000*, 998-C1004.

Sprott, D. (2000). *Componentizing the enterprise application packages. Communications of the ACM*, 43(4), 63-C69.

Stein, E. and Vandenbosch, B. (1996). *Organizational learning during advanced system development: Opportunities and obstacles. Journal of Management Information Systems*, 13(2), 115-C136.

Stein, E. and Zwass, V. (1995). *Actualizing organizational memory with information systems. Information Systems Research*, 6(2), 85-C117.

Swanson, E. B. (2000). *Information systems as buzz. AMCIS2000*, 923-C925.

Van Stijn, E. and Wensley, A. K. P. (2001). *Organizational memory and the completeness of process modeling in ERP systems: Some concerns, methods and directions for future research. Business Process Management Journal*.

Van Stijn, E. and Wijnhoven, F. (2000). *Diagnosing organizational memory mismatches in the ERP usage stage. AMCIS2000*, 655-C662.

Walsh, J. P. and Ungson, G. R. (1991). *Organizational memory. Academy of Management Review*, (16), 67-C91.

Weick, K. E. (1969). *The Social Psychology of Organizations*. Reading, MA: Addison-Wesley.

Willcocks, L. P. and Sykes, R. (2000). *The role of the CIO and the IT function in ERP. Communications of the ACM*, 43(4), 32-C38.

Zigurs, I. and Buckland, B. K. (1998). *A theory of task/technology fit and group support system effectiveness. MIS Quarterly*, 22(3), 313-C334.

Chapter 17: Big-Bang ERP Implementation at a Global Company

Nava Pliskin, Marta Zarotski, Ben-Gurion University of the Negev, Israel

EXECUTIVE SUMMARY

Dead Sea Works is an international multi-firm producer of Potash and other chemicals whose sales for 1998 were about \$500 million. In 1996, the Information Systems group convinced top management to pursue a big-bang ERP implementation of SAP R/3. To reduce project risk, risk management was practiced. First, only modules that matched the functionality of the then-existing systems were targeted, avoiding as much as possible software modifications and process reengineering. Second, a steering committee was set up to handle conflict resolution and set priorities throughout the project and top users were given responsibility with implementing modules within their respective functions. R/3 went into production on July 1, 1998, six months ahead of schedule and without exceeding the \$4.95 million budget.

BACKGROUND

Dead Sea Works Ltd., one of 15 member companies of Israel Chemicals LTD, is a producer of Potash and other chemical products from the mineral-rich Dead Sea, Israel's greatest natural resource. Situated at the lowest place on earth, it lies in a valley whose southern part is suitable for evaporation pans and enjoys ample sunlight for most of the year. This combination of chemical riches and topography that is amenable to practical use fired the imagination of Theodore Herzl, the father of modern Zionism. After hearing of a plan to extract minerals from the Dead Sea, during his 1896 visit to Palestine, Herzl described in his book, *Alt Neuland*, a Jewish State whose economic strength would be derived from the treasures of the Dead Sea.

Moshe Novomeisky, chemical engineer, came from Siberia to Palestine at the beginning of the century inspired by *Alt Neuland* to turn this vision into a reality. In 1930, he obtained from the British Mandatory authorities a concession to extract minerals from the Dead Sea, established the Palestine Potash Company LTD, and constructed a plant in the northern part of the Dead Sea. In 1934 evaporation pans and a chemical plant were constructed in Sodom as well. This became the foundation for today's Dead Sea Works (DSW) which, since it was reestablished in the 1950s, has increased production steadily to its current level of close to three million tons of Potash per year. In addition to Potash, DSW produces Magnesium Chloride Flakes and Pellets, Salt, Bath Salts, Magnesium Metal, Chlorine and Bromine.

Instead of mining, as do most of its competitors, DSW extracts Potash from the Dead Sea. The production process begins with the pumping of Dead Sea water to 105 square-kilometer salt pans, where the solution is concentrated. An additional forty square-kilometer pans are then used to crystallize materials, which after settling on the pan floor, are pumped by harvesters directly into refineries. In this process, DSW takes advantage of the energy of the sun, another important natural resource in the region. Artificially, these drying processes would require 10 million tons of oil per year.

Wherever Potash is produced, transportation is a major expense, as was the case for DSW because of the 900-meter altitude difference between the factory at Sodom, the lowest point on earth, and the nearest railway terminal. Since this gradient rules out the possibility of a direct rail link and the remote location makes road transportation expensive, DSW chose to build from Sodom to the railway an 18-km conveyor belt, whose incline at some points reaches 18 degrees. Since its completion in April 1987, DSW's transportation costs have declined substantially.

Currently, the multi-firm DSW Group (see [Exhibit 1](#)) is distributed internationally (e.g., Europe, and China) and within Israel (e.g., Sodom, Beer-Sheva, and Eilat). In Europe, DSW has been involved in several joint ventures. In 1996, DSW established Dead Sea Magnesium LTD., investing with Volkswagen (65%, 35%) close to \$500 million. Yearly production capacity at the new plant has already reached 25,000 tons and, by the end of 1999, is expected to grow by 50%. In 1998, DSW has partnered with Eurobrom B.V. in Clearon Holding Corporation and acquired from the Spanish-Companies Authority, jointly with two Spanish partners, Grupo Potash, a producer of one million tons of Potash per year sold mainly to the Spanish and French markets. In late 1998, DSW joined the Chinese government in building a Potash production plant that will eventually produce 860 thousand tons every year. This joint venture is expected to increase DSW's sales to China, a market whose Potash consumption per year grows at a rate that exceeds the world's rate.

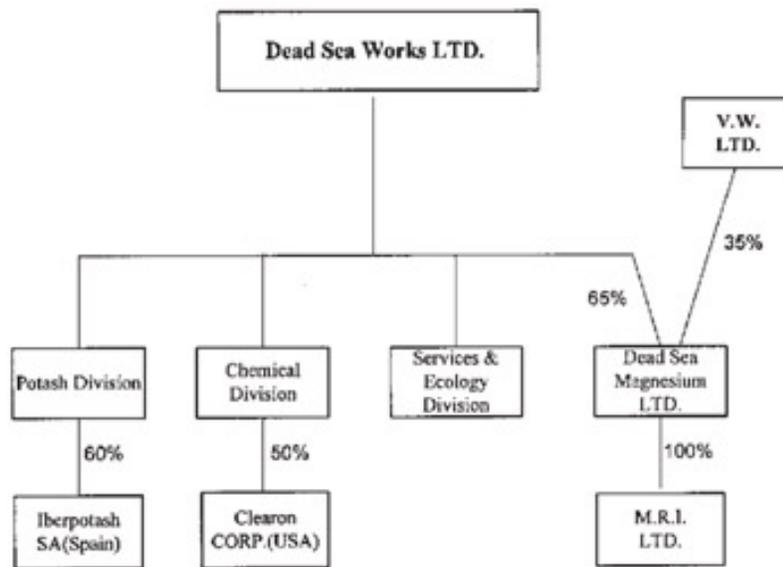


Exhibit 1: DSW Multi-firm Structure

Due to these expansion activities, the number of DSW employees almost doubled over the last two years, reaching 2,458 at the end of 1998. Potash sales worldwide, which reached about 42 million tons in 1998, are growing at a rate of 3% each year (see [Exhibit 2](#)). The American and Asian markets are the biggest Potash consumers and importers, since their own production does not meet the demand. DSW sells to 50 countries on every continent, protecting itself from local market fluctuations, and is expected to increase its share in world Potash production from six to nine percent. Even though 10% of its sales are directed to one of its clients, DSW is not dependent on any one customer. It is also free from dependence on any supplier and any material that is not included in its license from the Israeli government.

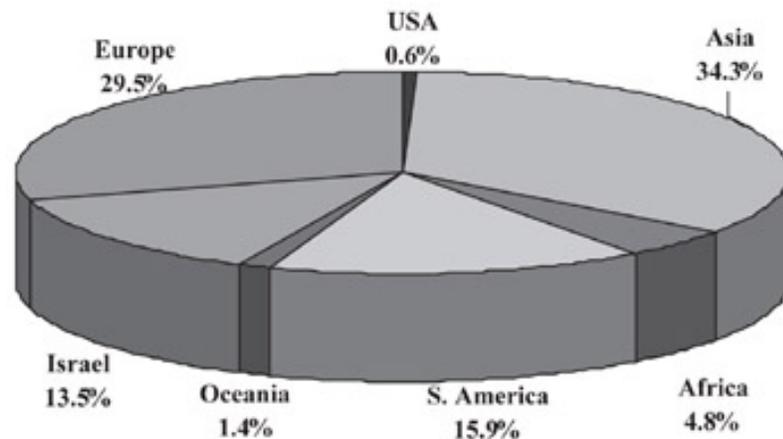


Exhibit 2: World-wide Potash Sales

Because DSW is a global company, its financial performance depends on trends in the world economy, including the economic conditions in South East Asia, Russia, and changing attitudes toward the environment. Despite periods when world Potash prices reached record low levels, DSW recorded a profit every year since 1970, while many of its competitors have faced difficulties (see [Exhibit 3](#)).

FINANCIAL FIGURES (in thousands of U.S. dollars)	1993	1994	1995	1996	1997	1998
Revenues	245,342	295,910	362,280	357,567	453,185	493,710
Net Income	17,852	28,013	35,171	39,840	39,645	49,901
Total Assets	526,462	628,092	742,182	934,450	983,598	245,460
Shareholders' Equity	305,703	320,109	333,005	351,372	368,415	418,468
Dividend Paid	21,792	13,907	13,917	21,220	36,808	9,680
Capital Expenditures	134,400	156,400	216,400	306,321	126,460	57,816
Earnings \$ Per Share of NIS 1 par value (in \$ U.S.)	0.06	0.10	0.12	0.13	0.13	0.17

QUANTITY FIGURES (in thousands of Metric Tons)	1993	1994	1995	1996	1997	1998
Potash Production	2,182	2,099	2,207	2,492	2,481	2,860
Potash Sales	1,968	2,317	2,451	2,178	2,861	2,916
Casted Magnesium Production	-	-	-	-	7.2	24.5
Casted Magnesium Sales	-	-	-	-	5.4	15.1
Table Salt Sales	58	63	80	86	104	99
Magnesium Chloride Flaked and Pellets Sales	51	74	81	90	68	63
Bath Salts Sales	1.3	2.2	1.9	1.9	2.2	2.1
Pan Salts Sales	268	235	178	191	261	219
Number of Employees	1,629	1,654	1,670	2,030	2,245	2,103

Exhibit 3: DSW Performance Highlights

Strategically, DSW is focused on persistent growth by taking the following measures. First, DSW is constantly expanding Potash production in Sodom and elsewhere, while lowering costs. Second, DSW is accelerating business development around the world (e.g., in China and in Spain), including joint ventures in Salt and Chloride Aluminum. Third, DSW is investing in development of power and water resources. Finally, in the marketing arena, DSW is paying attention to widespread distribution of sales, sensing customer needs and responding to them.

SETTING THE STAGE

Information Systems (IS) at DSW were custom-developed specifically for DSW since the early 1970s, when the IS unit consisted of an IS manager, six dataentry clerks, three operators, and four programmers. The first functions to be automated, in batch mode, were accounting, costing, and budgeting. The number of users in those early days was 20. When hardware was upgraded in 1978 to IBM's System 3 Model 15, each functional IS was operating in isolation, using its own removable disk.

A technological turnaround took place in the 1980s in terms of both hardware and software. The IBM 4331 mainframe computer running the VSE operating system was acquired, setting the stage for later upgrading to an IBM 4341 and a 4341-31 that operated in parallel respectively for IS production/operations and for development/testing. In the software arena, the purchase from Cincom of Total, a hierarchical Data Base Management System (DBMS), and Mantis, the associated development tool, set the stage for upgrading to the Supra DBMS a few years later. With a DBMS in place, DSW recruited a number of systems analysts and expanded its IS group to include ten programmers, adopting a systems approach and building integrated systems that replaced fragmented ones.

Microcomputers also made their way into DSW during that time. Except for the first stand-alone system, all operated in terminal-emulation mode. By the nineties, microcomputers ran applications developed by the IS group, as well as user-developed applications.

Until the early 1990s, the following process was in place for IS renewal and maintenance: The IS group took the initiative by conceiving an idea, and then approached top management for a budget to turn the initiative to reality. This changed considerably when a new manager took charge of the IS group in 1992. Under his leadership, users were encouraged to take IS initiatives and to convince top management to allocate the needed resources. This approach allowed better budgeting, in advance, according to user requests. Consistent with this approach, the mission of the IS group was redefined as service provision and workshops for IS personnel were conducted to teach how to become high-quality service providers.

Additional changes, which had a major effect on IS management at DSW, occurred after a new CEO, who perceived the information resource as instrumental to business success, took office in 1993 and restructured DSW (see [Exhibit 4](#)). The IS group turned into a division, instead of a department, and its head was promoted to Vice President of Information Systems (VPIS), reporting to the Senior VP and CFO, instead of the VP of Accountancy and Control. A consulting company hired around that time helped DSW in its IS planning processes. For the long term, the consultants helped put together a five-year IS investment plan. For the shorter term, they recommended that users be allowed to seek IS services outside DSW and, at the same time, be charged for IS services that they opt to acquire internally from the IS group.

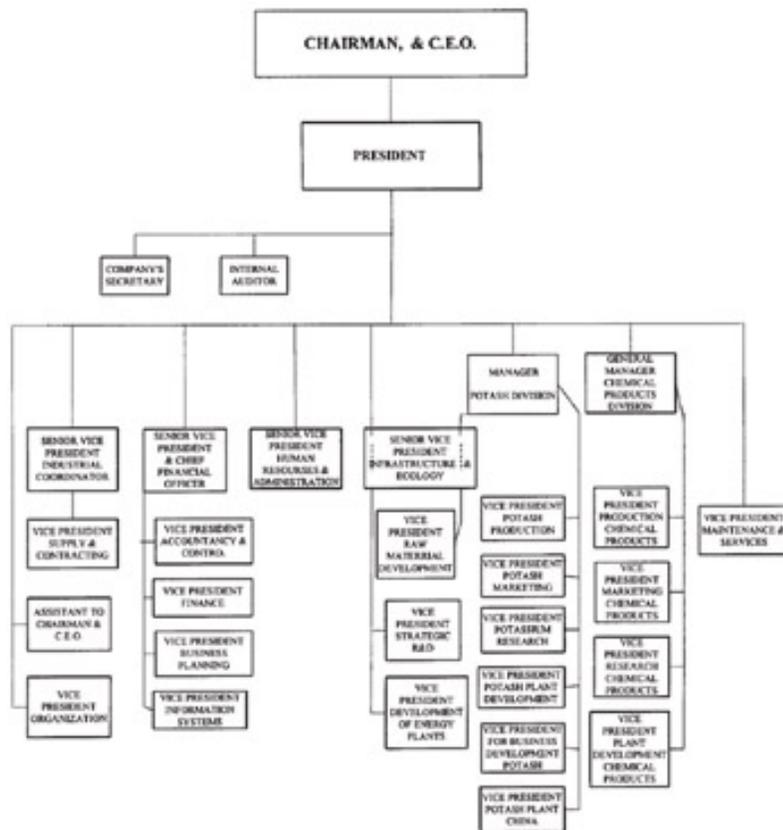


Exhibit 4: DSW Structure

In 1993 the mainframe hardware was upgraded to ES/9000 with the VSE/VM operating system. In the communication arena, LAN and WAN infrastructures were installed, using Novell and TCP/IP. By 1995, the IS environment at DSW was serving 700 satisfied users (100 used dumb terminals and 600 used microcomputers). Despite the fact that the functional information systems at DSW were consistent with major business processes, it became clear that major IS changes were called for due to technological and organizational reasons. Technologically, the Supra DMBS was no longer being supported and the systems at DSW were not state-of-the-art. Organizationally, the functional systems, which were developed to support the functioning of a single firm, could no longer support a multi-firm enterprise.

By 1995 the CEO and VPIS were well aware of the seriousness of the Year 2000 (Y2K) problem and concluded that for DSW, as for many other firms, resolution of the Y2K problem was critical to survival (Kappleman, 1997; Violino, 1997). Acknowledging that Y2K compliance was more of an organizational than a technical concern, the CEO charged the VPIS and the VP of Strategic R&D with planning how best to invest DSW financial and other resources to meet this challenge.

Like many organizations, DSW sent letters to all its suppliers in order to find out what their response to the Y2K problem was. In parallel, outside consulting services were recruited to help deliver Y2K solutions for embedded systems at a cost of about \$0.5M. Both these activities are beyond the scope of this case study, which is focused as a main issue on a big-bang implementation of an Enterprise Resource Planning (ERP) system at DSW. The ERP implementation resulted from the Pandora's box that was opened following the realization that the information infrastructure and the IS applications at DSW were not Y2K compliant.

CASE DESCRIPTION

Decision Making Leading to ERP Implementation

To assess resource implications of converting all IS applications to comply with Y2K, the IS group prototyped Y2K conversion of one functional application. Based on this prototype, they concluded that Y2K conversion of all existing applications would cost more than \$1.5M and would still leave DSW with legacy systems that revolve around a legacy DBMS.

The VPIS thus began to seriously consider avoiding Y2K conversion altogether and, at the same time, shifting from a "make" strategy to a "buy" strategy (Applegate et al., 1999.) As a subscriber of reports from META Group and GartnerGroup (1994-1996), he had already been exposed for a number of years to the growing popularity of the "buy" strategy, in general, and ERP, in particular. He was well aware that a number of software vendors offer ERP systems that integrate, on the basis modern database-management technology, a collection of modules for managing such functions as production, inventory, procurement, accounting, sales, marketing, and personnel. Although some vendors have originally developed their ERP products for mainframes, most made the transition to state-of-the-art client-server architectures.

The VPIS was also aware that some DSW competitors had already implemented ERP versions adapted to the chemical industry a few years earlier. Yet, until faced with the Y2K problem, he thought that ERP was intended either for larger and more global organizations than DSW was at the time, and/or for organizations whose IS applications, unlike DSW's, were fragmented islands of automation. Although module fragmentation was not one of DSW's problems, DSW could use an ERP package since it grew and became a multi-firm global firm.

Technologically, since none of DSW's existing applications were state-of-the-art, the VPIS expected ERP systems to be significantly superior in terms of speed and reliability. He also was aware that the core database, which was already stretched to the limit in terms of size and response time and was no longer being upgraded or even supported, was not suitable for handling globally distributed databases. Moreover, unlike ERP systems, each of the existing applications at DSW had its own user interface, making it inconvenient for users to move between applications and difficult for IS professionals to maintain data security as the number of users increased.

After becoming aware of ERP technical benefits, including speed, reliability, database distribution, convenience, and data security, the VPIS, VP of Strategic R&D, and their team began to consider the organizational implications of ERP. They soon learned that since ERP encompasses the whole organization at all sites, an ERP implementation can provide an opportunity for reengineering major organizational process and for achieving better business outcomes over time as a result of more informed managerial decision making processes.

Because of the perceived technical and organizational benefits of ERP, the VPIS and the VP of Strategic R&D began to view the turn of the millennium as an opportunity rather than a threat. They thus proposed to top management of DSW and its parent company, Israel Chemicals LTD, to avoid a Y2K conversion altogether and implement instead a Y2K-compliant ERP system that would facilitate:

1. Renewing the hardware at DSW, from host-centric to network-centric and the software infrastructure at DSW, from outdated to modern;
2. Supporting the transition of DSW from single-firm to multi-firm structure and from local to global operations; and
3. Using the ERP implementation project at DSW as a pilot from which other members in the Israel Chemicals LTD group can learn.

Once top management approved the ERP implementation, a decision was made to abandon all upgrading of existing systems and to put on hold plans for developing new applications. For example, although the need for plant-maintenance automation was already acknowledged prior to the decision to move into an ERP environment, and even though it was already budgeted at \$1M, actual analysis, design, and development were suspended.

The search process that followed, for software and hardware, ended in choosing the R/3 ERP software package from SAP, the Oracle DMBS software from Oracle, and the server hardware from HP. The fit between R/3 and DSW's needs was excellent for the following reasons: a) SAP met the main functional requirements of DSW because its chemical-industry version of R/3 had already quite a number of

installations worldwide. b) According to reports from META Group and GartnerGroup (1994-1996) that the VPIS has read, the larger and more financially robust SAP was more likely to survive than its competitors. c) SAP was holding the biggest market share in the world, in general, and in Israel, in particular. d) SAP gained considerable experience with and has been considered especially suitable for international multi-firm enterprises. e) SAP was investing more in R&D than competitors. f) R/3 was localized in terms of language, currency, and regulations of many countries, including Israel, where SAP partnered with the ATL LTD, an experienced Israeli vendor with whom DSW has had good relations.

Toward the end of 1996, the resolutions made by top management at DSW guided the implementation project so as to increase the prospects of reaching successful completion of the R/3 implementation by January 1, 1999. Oriented towards thorough project and risk management, these resolutions aimed at carefully controlling project size, technology, and structure (Applegate, et al., 1999.)

In order to put an upper lid on project size, DSW chose to concentrate on implementing the functions which were already automated at DSW (financial accounting, material management (inventory, purchasing and MRP), controlling, treasury and human resources, rather than implement all R/3 modules. The only exception was plant maintenance, whose long-overdue automation was already budgeted for \$1M and then suspended following the decision to implement ERP. About half way into the R/3 implementation project, management decided to implement the R/3 plant-maintenance module as well, having received assurances that this could be done within the deadline for an additional \$70,000.

Another critical decision was to avoid parallel implementation and its associated interfacing efforts, opting instead for the more risky "big-bang" transition to R/3. Since IS professionals within DSW were unfamiliar with R/3 technology, management realized that outsourcing the big-bang implementation project could reduce project risk (McFarlan & Nolan, 1995.) By contracting IBM as the implementing vendor, DSW was able to overcome the pressing need for unique R/3 skills and knowledge.

Given the wide organizational scope of the R/3 implementation, including the need to deal with recent mergers and acquisitions, top management was determined to increase the structure of the implementation project and to facilitate smooth upgrades to new R/3 releases in the future (Bancroft, et al., 1998.) To achieve these goals, DSW resolved to avoid as much as possible both customization of R/3 to DSW needs, on the one hand, and process reengineering, on the other. As a rule, management was more willing to abandon old DSW processes and regulations, which could not be supported by R/3 without customization, than to permit modifying R/3 to these processes. Only under such circumstances, even though project policy discouraged process reengineering, there was willingness on the part of management to reengineer new R/3-supported processes and replace the old unsupportable ones.

The SAP/R3 Implementation at DSW

The outsourcing contract with IBM was signed on the last day of 1996 and the implementation project started on April 1, 1997. Since then, the VPIS reported once a month to the board of directors about progress made. The CEO was committed to the implementation project and regularly briefed managers at all levels about his vision and expectations. Members of top management became very involved in the implementation project and each was asked to assume responsibility, as a top user, for implementing modules within their functional area. To make sure that implementation ended on time and within budget, the project was broken up into milestones. Since meeting milestone goals and target dates was deemed critical, any delay needed top management approval.

Measures were taken to facilitate prompt decisive action. A steering committee was formed to set priorities, to handle conflict resolution throughout the project, and to promptly respond to problems. For each functional area, a joint team of three, composed of the respective top user (Pliskin & Shoval, 1989), an R/3 expert from IBM, and a systems analyst from DSW, was created. The team, assigned with responsibility for part of the implementation project, was put in charge of choosing among R/3 processes and reports and setting priorities. Since a significant portion of top-user time was allotted to the implementation, they developed familiarity with the new environment and, later on, became very effective in providing the initial response to problems that emerged. IS professionals were constantly briefed with respect to progress as well as with respect to difficulties and ways to get around them. They were encouraged to report any concern to the respective top manager to insure a fast solution.

As planned, R/3 modifications were limited to the absolute minimum and permitted under exceptional conditions and only with formal CEO approval. The formal procedure, instituted to discourage R/3 modifications, was practiced throughout the project, despite a number of unsuccessful attempts to eliminate it, especially during transition between CEOs.

Consistent with the initial intention to limit reengineering to a minimum, only a few processes were reengineered. The reengineered service entry process, for example, was perceived by users to be "the right thing to do" because it was dictated by R/3. They thus willingly adopted it before noticing that, because the new more reliable service entry process was 50% to 60% faster, a few jobs had to be

eliminated. In any case, none of the employees whose jobs were eliminated was asked to leave DSW. Instead, they were transferred to other departments that were hiring at the time.

It is noteworthy that DSW, which prior to the ERP implementation opted to custom-make IS applications, wished to gain as much as possible from its decision to buy software and, at the same time, increase prospects for success. In other words, DSW was willing to abandon customization as much as it could, putting a lid on modifications and willing to force modification avoidance except under special circumstances. In an organizational culture that values labor relations, a threat of labor unrest in the form of a strike presents such special circumstances. The union was therefore consulted whenever avoiding R/3 modifications impacted compensation. In at least one case, the union's disapproval of modification avoidance forced an R/3 modification and labor relations were not hurt. It is noteworthy however that the union was willing, in most cases, to go along with and accept the implications of modification avoidance.

Additional initiatives paralleled the ERP conversion. Personal computers and terminals were upgraded. The network was stabilized to prevent down times. Data quality was addressed (through conversion, improvement, and creation). Even though time was short, specially-hired trainers joined top users and systems analysts, who participated in the implementation project intensively (Pliskin, 1989), to train, in four parallel classrooms, 400 trainees, including end users, systems programmers, operators, systems analysts, and programmers. Each trainer was put in charge of specific modules. Trainees were encouraged to come to the classroom for extra practice. A flexible and responsive computerized help-desk was staffed with individuals trained to either respond promptly or to refer swiftly to another person.

R/3 went into production at DSW on July 1, 1998, six months ahead of schedule and without exceeding the \$4.95 million budget. In the beginning, the VPIS met with the IS professionals on a daily basis to air out problems. As the need to do so diminished, meeting frequency went down. As of January 1, 1999, all planned modules are working. The number of users, low- and mid-level managers, is 600 and growing.

It is noteworthy that both IS professionals and users cooperated with the ERP implementation and no resistance was observed. Although nobody in the company is willing to bet on the reasons for the lack of resistance, some speculations have been brought up. IS professionals were assured by the VPIS that their skills would be upgraded to state-of-the-art technologies through massive training and none would be fired. Users were led to believe that the R/3 implementation provided an opportunity for DSW to have modern information systems and provided with enough training to alleviate any fears about working with the new software.

As anticipated, the ERP implementation provided DSW with the opportunity to renew the hardware, from host-centric to network-centric, and to modernize its software infrastructure. Gradually, R/3 will be implemented at branches of DSW worldwide, helping DSW with the transition from single-firm to multi-firm structure and from local to global operations. The ERP implementation project at DSW served as a pilot, and the same ERP infrastructure is expected to make its way to other sister companies of DSW in the Israel Chemicals LTD. Implementation of R/3 by another Israel-Chemicals member is already approaching completion faster and cheaper than at DSW, under the leadership of an IS professional from DSW.

In retrospect, SAP R/3 has also provided DSW with some tangible savings: the number of pages printed per month was reduced by 80% from about 25000 to about 5000, because of the better ability to query online instead of printing reports. The number of shifts for server operations has gone down from 3 to 1.5 per day. With all batch processes substituted by on-line ones, information provision has improved in the sense that the raw data is now more up to date. Thus, for example, it is now possible to know in real time (as opposed to twice a week before ERP) what the real inventory levels are and, therefore, DSW is saving money on inventory without hurting production in any way. Because of the uniformity of screens for different modules, it is now possible to easily carry a transaction from one module to another (e.g., from a costing screen to a contractor screen). Another improvement has to do with the way materials are ordered from the warehouse. Until the ERP implementation, precious time was wasted when workers came to pick up materials without verifying availability beforehand. Under SAP R/3, pickup from the warehouse is permitted only after availability is verified through remote inquiry. DSW's employees accepted the R/3 process without resistance, despite failure to introduce a similar ordering process under the legacy systems in the early 1990s.

On the down size, there has also been some deterioration in information provision, especially for top managers who were accustomed to using the Commander Executive Information System. In some respects, they now have less access to information than before because Information-Center tools are not yet effectively integrated with SAP R/3. Even for lower levels of management, information provision is in some cases poorer than before because the design of several processes and procedures has been proven inappropriate. Some information provision processes now take longer and require navigation among a series of several screens whereas beforehand each of the same processes took only a single screen to complete.

In sum, DSW has already reaped substantial benefits from the strategic move to ERP. The hardware

has been renewed. The IS applications and DBMS have been upgraded to Y2K-compliant and fully integrated functional modules, with uniform and smooth transitions among them. The highly needed yet missing plantmaintenance module has been implemented. DSW processes have improved and become more efficient. Having implemented a multi-company solution, organizational learning can now take place at other DSW and Israel Chemicals LTD locations. IS professionals at DSW, whose skills have been upgraded significantly, can rely upon complete documentation and apply the same set of standards and tools, including ad hoc drill-down capability and advanced quality-assurance tools.

CURRENT CHALLENGES/PROBLEMS FACING THE ORGANIZATION

The long list of benefits and the current perception of ERP success within DSW stand in sharp contrast to the growing number of horror stories about failed or out-of-control ERP projects (Davenport, 1998.) Against this contrast, it is of interest to consider the starting conditions, goals, plans, and management practices that may have increased the chances of success at DSW.

Changes in the competitive environment in the 1990s pushed top management at DSW to approve funding for the ERP implementation in order to support company growth and restructuring from single-firm to multi-firm. The ERP implementation served strategic DSW goals such as improvement of business results, technology replacement, and reduction in the total cost of technology ownership. The ERP implementation has also created a platform for reengineering business processes in the future and for integrating the supply chain. ERP plans were well thought of, arguing a general business case in addition to a technical case. The fact that benefits have been reaped despite the limited scope and minimal modifications suggests that there was, to start with, a good fit between R/3 and the needs of DSW.

Management practices contributed to success as well. Contractual arrangements with vendors worked well and good working relationships were maintained within the implementation teams. Project management adhered to the following principles: the partial scope of the implementation was not changed during the project, except for adding the maintenance module, software modifications were avoided as much as possible; and sufficient investment was made in testing, data conversion, and user training. Even though a change of guard took place in the IS organization a few years prior to the ERP implementation, the fact that the new VPIS was not a newcomer to DSW contributed to the stability of the IS governance and experience. In retrospect, if given the opportunity to rethink management practices, the only thing DSW might have done differently is to let the IS professionals and top users in development teams work full time on the project away from DSW's premises.

It is important to acknowledge that no external events and changing conditions beyond DSW's control worked against the implementation either: financial conditions were good, there was no turnover of key personnel, and vendors neither overstated their expertise nor went out of business.

The IS group is dealing with problems and challenges by working on continuous improvement to the R/3 environment. One problem is that, probably due to the decision to opt for a big-bang implementation with only minimal reengineering and software modifications, some cumbersome and unfriendly work processes exist following the R/3 implementation. To correct this and allow DSW to better take advantage of what the R/3 environment can offer, DSW processes will be gradually reengineered and R/3 software modifications will be permitted. Thus, many efficient and effective processes that R/3 can support, but were not implemented so far, will eventually be introduced to DSW.

Another problem, which has resulted out of the decision to limit the volume of routine reporting, concerns poor design of some routine R/3 reports and user demands for additional reports. Work is ongoing to alleviate this problem; and poorly designed reports, especially those consumed by outside parties, are being redesigned. In addition, new additional reports are being planned, including control reports that are needed to support newly introduced procedural changes.

Finally, some DSW functions are not yet supported by R/3. To meet this challenge, implementation of additional R/3 modules is being planned, including project management, marketing, and production-planning. Also in the planning are systems to support senior-level decisions, such as a data warehouse and an executive information systems.

FURTHER READING

- Allen, B. (1998). Year 2000: Impact on the Healthcare Industry. *IS Audit and Control Journal*, (1), 11”C13.
- Ang, S. & Straub, D. W. (1999) Production and Transaction Economics in IS Outsourcing: A Study of the US Banking Industry. *MIS Quarterly*, 22(4), 535”C554.
- Benjamin, R. I. & Levinson, E. (1993). A Framework for Managing IT-Enabled Change. *Sloan Management Review*, (Summer), 23”C33.
- Henderson, J. C. & Venkatraman, N. (1993). Strategic Alignment: Leveraging IT for Transforming Organizations. *IBM Systems Journal*, 32(1), 4”C16.
- Jenkins, H. W. (1997). Turns Out the Year 2000 Problem is Just Beginning. *Wall Street Journal*, (May 6), A23.
- Mensching, J.R. & Adams, D.A. (1991) *Managing an Information System*. New York, NY: Prentice Hall.
- Pliskin, N. & Shoval P. (1987). End User Prototyping: Sophisticated Users Supporting Systems Development. *DATABASE*, 18(4), 7”C17.
- Rockart, J. Earl, M. J., and Ross, J. W. (1996). Eight Imperatives for the NEW IT Organization. *Sloan Management Review*, (Fall), 43”C55.

REFERENCES

Applegate, McFalan, & McKenney (1999). *Corporate Information Systems Management*. Boston, MA: Irwin McGraw-Hill.

Bancroft, N.H., Seip, H., & Sprengel, A. (1998). *Implementing SAP R/3: How to Introduce a Large System into a Large Organization*. Greenwich, CT: Manning.

Davenport, T.H. (1998) *Putting the Enterprise into the Enterprise System*. *Harvard Business Review*. (July-August), 212-213.

GartnerGroup Reports (1994-1996).

Kappleman, L., Editor (1997). *Year 2000 Problems: Strategies and Solutions from the Fortune 100*. London: International Thompson Publishers.

McFaralan, F.W. & Nolan, R. L. (1995). *How to Manage an IT Outsourcing Alliance*. *Sloan Management Review*, (Winter), 9-23.

META Group Reports (1994-1996).

Pliskin, N. (1989). *Human Resource Management: Guidelines for Effective Introduction of Microcomputer Technology*. *Journal of Information Systems Management*, 6(2) 51-58.

Pliskin, N. & Shoval P. (1989). *Responsibility Sharing Between Sophisticated Users and Professionals in Structured Prototyping*. *Information and Software Technology*, 31(8) 438-448.

Violino, R. (1997). *Year 2000 Getting Down to the Wire*. *Information Week*, (February 10), 14-15.

Chapter 18: Selecting and Implementing an ERP System at Alimentos Peru^[1]

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

OVERVIEW

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.

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

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*¹ a Chilean company² 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* brand names, 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*³ *Alimentos Peru's* brand name⁴ 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 lines⁵ bread-making ingredients, candies and chocolates⁶ *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 U.S. 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 set up 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 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 set up. 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^[2] 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](#)):

- 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 two-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 off-the-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-server Architecture
BPCS	“1	“1	“1	“1	“1
SAP R/3	“1	X	X	X	“1
PRISM	“1	“1	“1	“1	“1
J.D. Edwards	X	“1	X	“1	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, 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 to 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 three 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* U.S. 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]

The BPCS system would be implemented in the purchasing and warehousing, 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
-----------------	---------------------	--------------------

1. 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

2. 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 programming.

3. 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.

4. 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.

5. System trial runs

- Selecting real data to test each module.
- Stand-alone module testing.
- Interconnected module testing.
- Parallel trials using original systems and new modules.
- Implementation consultant
- Organization and methods specialist (one person)
- Implementation team
- IT division

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 six months.

The ERP system implementation teams were configured at head and supervisor 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 turn over 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 manager's 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 mindset. 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 three 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 three-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 three months. The sales and marketing modules took four 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 was at the source of many human mistakes and was 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 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 one week to just two 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.

^[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.

CURRENT CHALLENGES AT ALIMENTOS PERU

The implementation of the ERP system at *Alimentos Peru* ended in April 1999. A few months later, while he was 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, 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 mindset among sales people. *"The sales person 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
Current liabilities	9.615	14.648	14.673	21.647	20.119
Non current liabilities	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	41.451
Sales expenses	6.869	9.472	11.724	13.584	14.086
Overhead					
Total	44.447	51.624	54.707	57.141	58.679
RESULTS FROM OPERATIONS	3.992	2.694	5.951	5.915	3.186
OTHER REVENUES (EXPENSES)					
Financial revenues	119	109	138	162	161
Financial expenses	-1.505	-1.376	-1.216	-1.076	-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 PARTICIPATION	3.377	1.628	4.757	4.617	585
Participation				-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

Source: Alimentos Peru, internal documents

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:
 - o Logistics
 - o Employee Payrolls
 - o Accounting and Financial
 - o Commercialization
 - o Manufacturing
 - o Human Resources
2. Improve or replace basic systems using integrated systems including interconnected modules and applications for these areas, preferably with preprogrammed packages.
3. 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.
4. Organization-level recommendations:

- o Setting up an IT Steering Committee under the Management Committee to ensure basically that systems development would be aligned with business goals.
- o Enhance expertise in the IT division by hiring new personnel and training for present employees.
- o 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.

FURTHER READING

- Appleton, E. L. (1997). How to survive ERP. *Datamation*, 50°C53.
- Bancroft, N. H., Seip, H., & Sprengel, A. (1997). *Implementing SAP R/3*. (2nd ed.) Greenwich, CT: Manning Publications, Co.
- Davenport, T. H. (1998). Putting the Enterprise into the Enterprise System. *Harvard Business Review*, 76(4), 121°C131.
- Davenport, T. H. (2000). *Mission Critical: Realizing the Promise of Enterprise Systems*. Boston: Harvard Business School Press.
- Hecht, B. (1997). Choose the Right ERP Software. *Datamation*, 43(3), 56°C58.
- Langenwalter, G. A. (1999). *Enterprise Resources Planning and Beyond: Integrating Your Entire Organization*. CRC Press-St. Lucie Press.
- Norris, G., Dunleavy, J., Hurley, J. R., Balls, J. D., & Hartley, K. M. (2000). *E-Business and ERP: Transforming the Enterprise*. John Wiley & Sons.
- Shtub, A. (1999). *Enterprise Resource Planning (ERP): The Dynamics of Operations Management*. Kluwer Academic Pub.