University of Warwick institutional repository: http://go.warwick.ac.uk/wrap

A Thesis Submitted for the Degree of PhD at the University of Warwick

http://go.warwick.ac.uk/wrap/73548

This thesis is made available online and is protected by original copyright.

Please scroll down to view the document itself.

Please refer to the repository record for this item for information to help you to cite it. Our policy information is available from the repository home page.

Development of a Model of Internal Diffusion and Infusion of Enterprise Systems

by

Oswaldo J. Lorenzo Ochoa

Thesis submitted for the fulfillment of the requirements for the degree of Doctor of Philosophy in Industrial and Business Studies

University of Warwick, Warwick Business School

January, 2004

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

I am grateful to so many people who have kindly helped in some way to make this dissertation possible.

I wish to thank my supervisor, Dr. Peter Kawalek who has provided very skillful guidance and insightful comments. To my co-supervisor, Dr. James Storbeck who has been extremely helpful in providing invaluable advice on improving the quality of my thesis.

To Instituto de Estudios Superiores de Administración (IESA), especially Dr. Paul Esqueda and Dr. Angel Díaz, who encouraged me to start my PhD study and have provided inestimable guidance in the development of my academic career. To Gastón González who has advised me during my PhD study. To my friends Rafael, Fer, Pavel y Lud who helped my family and me in a number of ways in the completion of this project.

To over seventy business managers and specialists participating in this study who contributed to the multiple case study, responded my questions or coordinated with the managers in their organizations. Specially to Juan C. González, Rafael Hernández, and Antonio Vicentelli.

To my parents who always encouraged me in my professional development and, alongside my parents-in-law, have supported my PhD study. Finally, and the most important, to my wife, Anna, and my sons, Rosanna and Juan José, who had to bear with my absence in many family activities over four years and who are my source of continuing inspiration.

DECLARATION

None of the materials contained in this thesis has been submitted for publication prior to the start of candidature. However, some of the work in the thesis has been published or submitted for publication in refereed international conferences or journals prior to the completion of this thesis.

SUMMARY

After most large industrial companies have installed enterprise systems (ES), the managerial concern moves to the effective diffusion and infusion of ES throughout a company. Diffusion means the degree in which a system has been shared throughout the company and infusion is the degree in which a system has penetrated a company in terms of importance, impact, and significance. Little of the ES literature has considered these new larger issues.

This thesis develops a model of internal diffusion and infusion of ES. The ES diffusion model presents the ES implementation as an iterative, cumulative, and virtuous process over time. The model recounts and validates the authentic characteristics of ES projects, places "use" as both product and fomenter of the implementation activity, and putting emphasis upon the importance of experiential learning. The ES infusion model develops a framework of ES capabilities to analyse the extent and quality of the use of ES in organizational contexts (i.e. infusion).

To investigate these issues this research has borrowed the perspective of organizational introduction of a technological innovation from the innovation discipline. The scope of the investigation is limited to three selected organizations overseas, which had each already installed at least a single functional component of the system and had decided (or was working on) the diffusion of the system in further departments or locations. The data collection was a combination of retrospective and real-time analysis. Hence, a multiple-case studies for constructing theory from the observed field data was developed.

ABBREVIATIONS

ABC: Activity-Based Costing

ACM: The Association for Computer Machinery

AM: Assets Management Functionality

AMCIS: The Americas Conference on Information Systems

AMR: Advanced Manufacturing Research

APICS: American Production and Inventory Control Society

ARIS: Architecture of Integrated Information Systems

B2B: Business-to-Business

BI: Business Intelligence

BOM: Bill of Materials

BSC: Balanced Scorecard

BPR: Business Process Redesign

CAIS: Communications of the Association for Information Systems

CC: The Coffee Company

CEO: Chief Executive Officer

CFO: Chief Finance Officer

CPC: The Chemical Products Company

CRM: Customer Relationship Management

CSO: Customer Sales Order

CSF: Critical Success Factors

CO: Controlling Functionality

D&S: Distribution and Sales Functionality

DRP: Distribution Requirements Planning

DSS: Decision Support Systems

EAI: Enterprise Application Integration

EIS: Enterprise Information System Functionality

EJIS: European Journal of Information Systems

ERP: Enterprise Resource Planning

ES: Enterprise Systems

ESC: The Engineering Service Company

ESEC: The Enterprise Systems Experience Cycle

EUCS: End User Computing Satisfaction

FA: Financial Accounting Functionality

FIFO: First In First Out

HBR: Harvard Business Review

HHC: Hand Help Computers

HR: Human Resource Functionality

ICIS: International Conference on Information Systems

IJIM: International Journal of Information Management

IS: Information Systems

ISJ: Information Systems Journal

ISR: Information Systems Research

JIT: Journal of Information Technology

LIFO: Last In First Out

MISQ: Management Information Systems Quarterly

MM: Materials Management Functionality

MRP II: Manufacturing Resource Planning

MRP: Materials Requirements Planning

PACIS: Pacific Conference on Information Systems

SCM: Supply Chain Management

SLC: Software Life Cycle

TTF: Task-Technology Fit

CHAPTER 1: INTRODUCTION

Since the beginning of 1990s, an important innovation has shaped the way organizations operate their business processes and information systems; the enterprise system (ES)[1]. These systems have been implemented by thousands of companies worldwide. For instance, by 1998 about forty percent of companies with annual revenues over $1 billion had implemented an ES (Caldwell and Stein 1998). James and Wolf (2000) point to an investment of $300 billion in ES during the 1990s. These facts suggest that many businesses are convinced of the necessity and benefits of an ES. The attraction of these systems is related to their ability to integrate all the information flowing through a company, bringing huge improvements in organizational efficiency and effectiveness – for instance, standardized processes, lower back-office staff requirements, faster delivery time, reduced inventory and improved customer service (Davenport 1998; James and Wolf 2000).

While ES can result in great rewards, their risks are also great (Davenport 1998). The ES implementation is definitely a complex voyage with high chances of failure. The road for reaching these benefits may be painful with angry employees, personnel turnover, costly reengineering processes, and projects that seemingly never end (Worthen 2002; Davenport 1998; Lorenzo 1998b). The literature reveals that many implementations of these systems have failed over the project phase or have failed to reach the original promise (i.e. expected business results) after the system has gone live (Buckhout *et. al.* 1999; Davenport 1998). On the other hand, in a more positive light, ES is commonly advocated as a means of changing the way an organization works. Much evidence reflects that an ES imposes its own

[1] They are also known as Enterprise Resource Planning (ERP) systems.

logic on a company's processes, strategy, and culture (Davenport 1998; Markus and Tanis 2000). Given the big implementation challenges and the corresponding business implications, enterprise systems can be considered as an important contemporary phenomenon in organizational adoption and use of information technology (Markus and Tanis 2000).

This chapter explores the characteristics, importance and problematic character of Enterprise Systems and their implementation, diffusion and use inside organizations. The chapter then argues for the need of a broader technological diffusion perspective, which allows academics and practitioners to reach better understanding of the ES phenomenon. Finally, the objectives, the scope of the study and the structure of the thesis are addressed.

1.1 Enterprise Systems

Enterprise systems "enable the integration of transactions-oriented data and business processes throughout an organization" (Markus and Tanis 2000, p. 4). The base of an ES is a single database that receives data from and feeds data into an associated set of modular applications. These modular applications support different company functions such as sales, finance, human resources, and manufacturing. When new information is entered into a modular application, related information is automatically updated for the others (Davenport 1998). ES are also able to encourage integration of different business units or facilities located that geographically scattered around a country or abroad.

This modular constitution brings particular characteristics to the ES implementation process. One of them is that companies can install the system under a phased scheme in which each phase encompasses the implementation of a set of functionalities or just one of them. But, each phase is just a part of the entire journey. Companies have to implement the system throughout all departments, divisions or locations for realizing the value that integration provides (Shepherd 2001; Davenport 1998). As a consequence, the complete implementation of ES and reaching the expected business benefits may become a long-term journey – mainly in big companies.

The other principal characteristic is that ES are standard, off-the-shelf, commercial packages, which are purchased from software vendors (Markus and Tanis 2000). The main technical differentiator to traditional information systems is that when an organization adopts an ES, it does not design a new system to meet its extant or proposed ways of working. Instead, there is much greater emphasis on the organization adapting its business processes to the package's generic functionality. When installing the ES, companies may have to fit their business process to the system's requirements. Typically this will involve some degree of business process redesign (Davenport 1998; Markus and Tanis 2000). The major technical activity installing the system is the configuration process, which implies setting software parameters to tailor the system to reflect particular organizational models and business rules (Brehm *et. al.* 2000). It follows that both business process redesign and software configuration are key spheres of activity in any ES project.

1.2 The ES Challenge: Implementation, Diffusion & Use

The ES literature reveals that many implementations of these systems have failed in the project phase (Buckhout *et. al.* 1999; Scott 1999; Davenport 1998), have failed to diffuse and incorporate the system throughout the organization's operations and activities (Shepherd 2001; James and Wolf 2000; Gilbert 1999), or have failed to reach the expected business benefits after the system has gone live (Shepherd 2001; Markus and Tanis 2000; Davenport 1998).

According to a Standish Group's study in companies with more than $500 million in revenues, few ES implementations hit their project targets; that is costs, schedule and functional scope (Buckhout *et al.* 1999). Some of these stories have ended up as horror cases in which, after millions of dollars invested, a project was cancelled (Scott 1999; Davenport 1998; Lorenzo 1998b). The study of causes of failure of these stories has originated several responses. Most research on ES has been undertaken to understand the implementation problems in project phases and which factors encourage the success. Such factors research has generated a set of issues that appear to be related to ES success and failure. For instance, business vision (Holland and Light 1999; Davenport 1998), management support (Parr *et. al.* 1999; Holland and Light 1999), the organization of the project team (Newell *et al.* 2001; Bancroft 1998), minimal customisation (Parr *et. al.* 1999; Brehm *et. al.* 2000; Bancroft 1998), and communication and training (Couillard *et. al.* 1999; Bancroft 1998).

The ES implementation literature also reveals that many organizations have been able to install ES, in the sense that they have the system available for use, but have failed in their efforts to diffuse and incorporate it throughout the organization's daily practices (Smyth 2001; James and Wolf 2000; Stedman 1999; Gilbert 1999). To reach the diffusion challenge, two major activities seem to be necessary: 1) a continuous-improvement mindset and fine-tuning of the software

(Markus and Tanis 2000; James and Wolf 2000; Couillard *et. al.* 1999); and 2) the deployment to additional departments, divisions, and locations (Shepherd 2001).

Finally, companies that already have ES in place are asking themselves whether they are able to realize value from their ES investments (James and Wolf 2000; Irving 1999; Davenport 1998). Most companies that have implemented an ES seem to be focusing on creating tactical value (e.g. transaction automation) instead of strategic value (e.g. customer service) (Davenport 2000). This suggests that ES have not fully penetrated companies in terms of higher level of organizational objectives and uses. For some authors (Davenport 2000; James and Wolf 2000), companies can develop the ES capabilities through a "staircase of value" beginning from cost savings, following with progress into process efficiency and effectiveness until finally achieving competitive advantage. However no work has investigated this pattern in depth.

1.3 ES Implementation: The need of a broader perspective

Although ES implementation is a young research field, considerable progress has occurred over its short life. Important findings have been presented in the literature referenced above and elsewhere. However, our understanding of ES implementation is as yet incomplete. The ES implementation literature remains fragmented with most studies following a factors research stream, consistent with the influence of this stream in recent information systems implementation research (Nandhakumar 1996; Reich and Benbasat 1990; Sanders and Courtney 1985). An exception is the Markus and her colleagues' works (2000). They have modelled the ES experience and the dynamics of ES success through the Enterprise Systems

Experience Cycle. Following emergent process theories (Soh and Markus 1995; Orlikowski and Robey 1991), they argue that ES can be described as moving through several phases, characterized by key players, typical activities, characteristics problems, performance metrics and a range of possible outcomes.

After most large industrial companies have installed ES, the managerial concern is moving to the long-term ES requirements and challenges related to maintenance, support, continuous improvement and changes, continuous training, spreading the systems throughout the company beyond first installation, using the system to its complete potential, and realizing the expected benefits (Shepherd 2001; Light 2001; Brehm *et. al.* 2000; Davenport 2000; James and Wolf 2000). As the first implementation phases, activities related to improvements, diffusion and use are also characterized by the involvement of a large number of stakeholders (Soh *et. al.* 2000), the assimilation of a large amount of knowledge (Soh *et. al.* 2000; Couillard *et. al.* 1999) and the development of additional user skills (Markus and Tanis 2000).

Given the above evidence, the effective diffusion of ES throughout a company and the extent of ES infusion inside companies have become new managerial concerns. Diffusion means the degree in which a system has been shared throughout the company (Kwon and Zmud 1987; Sullivan 1985) and infusion is the degree in which a system has penetrated a company in terms of importance, impact, and significance (Cooper and Zmud 1990; Sullivan 1985).

To study these issues in the ES context one can borrow the perspective of organizational introduction of a technological innovation from the innovation discipline (Rogers 1995; Kwon and Zmud 1987; Kimberly 1981). For Kimberly (1981), the theoretical issue under this perspective is understanding why and how an innovation spreads inside an organization, that is its internal diffusion. He states clearly the problem when concludes: "...adoption, implementation and use of an innovation in one organizational subunit does not lead naturally and inevitably to widespread use throughout an organization" (Kimberly 1981, p. 91). This perspective is appropriate for reaching better understanding of the ES phenomenon because it concerns the implementation process beyond the installation stage. Different authors represent distinct stages in the implementation of a technological innovation. But all of them seem to agree that the process finishes when the usage of the technology is encouraged as a normal activity - i.e. routinizing or infusion (Rogers 1995; Coopers and Zmud 1990; Kimberly 1981). Hence, under a technological innovation perspective, diffusion and use of the technology is part of the implementation issue.

This perspective has been widely used in the implementation of many other kinds of information systems (Cooper and Zmud 1990; Kwon and Zmud 1987; Sullivan 1985). For Kwon and Zmud (1987) information systems implementation can be defined as an organization effort to diffuse an appropriate IT within a user community. They have developed an IT implementation research model, which is based on the organizational change, innovation, and technological diffusion literature. Afterwards Cooper and Zmud (1990) used this model to study the implementation of production and inventory control information systems. On the other hand, Sullivan (1985) studied the relationships between the extent of diffusion and infusion of information systems and the distinct practices of information systems planning.

The special characteristics of ES explained above re-motivate an enquiry into this topic. Given its sheer scale and its standardized functionality, the processes of diffusion and infusion might be quite distinctive. This work adds to this research stream by looking at ES implementation as an effort in technological diffusion within a user community. This is a broader perspective upon ES implementation, and relates to the earlier body of IS research (Cooper and Zmud 1990; Kwon and Zmud 1987).

1.4 Objectives and Scope of Study

As described above, most ES studies have focused on small pieces of the ES implementation puzzle and most of them have followed the factors research stream. On the other hand, few works have considered these new larger issues related to diffusion and infusion of the enterprise systems throughout a company. It is not yet known, for example, how widely these technologies have been diffused and assimilated in organizations, how extensively they are used inside organizations, or how effectively they are used (Markus and Tanis 2000). Hence this work revisits some key information systems themes – the innovation and diffusion of information systems – but in the changed context of ES.

For this, this investigation aims to study the following research questions:

1. How do ES diffuse inside organizations?
2. How do ES infuse inside organizations?

The following research objectives are stated to address the above problem questions:

1. To develop a model of diffusion of ES that allows academics and practitioners better understanding of the activities and events occurring in the

implementation and internal diffusion of ES features throughout an organization.

2. To develop a model of ES capabilities (ES uses) and apply this model to analyse how ES infuse inside organizations.

The study borrows the perspective of technological innovation, which has already been used in both the innovation and information systems disciplines (Rogers 1995; Kimberly 1981; Kwon and Zmud 1987). This brings clear benefits to the study. Firstly, many of the concepts and theoretical issues have already been identified by others researchers. Secondly, for the theoretical and practical implications, the study will allow academics and practitioners to see the ES phenomenon in a new way, bringing forward better understanding of the ES implementation.

The scope of this investigation is limited to the study of three selected organizations overseas. They had each already installed at least a single functional component of the system (in the sense that it was ready to be used or was already being used) and had decided (or were working on) the diffusion of the system in further departments, divisions or locations. They were also embedded in activities related to the system's maintenance, support, continuous improvement, and training. The data collection was a combination of retrospective and real-time analysis. Hence, a multiple-case studies for constructing theory from the observed field data has been developed (Miles and Huberman 1994; Eisendhart 1989).

1.5 An Outline of the Thesis

This thesis is organized as follows: Chapter 2 reviews the ES origins, technical and functional characteristics, and business implications. Chapter 3 discusses the existing literature related to ES research, in general, and ES implementation, in particular. It then suggests for the need of a broader perspective to tackle the ES implementation problem. A technological innovation perspective is borrowed from the IS implementation literature and from the innovation literature. Finally this chapter identifies and analyses the most important works related to this broader perspective. Chapter 4 describes the research approach, design and justifications for using a qualitative perspective. Chapter 5 and 6 reports the findings from the cross-case analysis in order to explain the model of diffusion and the infusion process that emerge from the investigation. Chapter 7 provides a critical review of the models and conclusions reached, the contributions, implications and limitations of this study and, additional topics to develop in further ES research from this investigation. References and Appendices are provided to support information.

CHAPTER 2: A COMPREHENSIVE REVIEW OF ENTERPRISE SYSTEMS

This research relies on the comprehension of the Enterprise Systems' functional and technical characteristics. It follows from this that the objective of this chapter is to introduce the several features of ES. To do this, five sections are written below. First, the origins of the ES from manufacturing concepts and systems are presented. This section also describes the extension of ES from back-office applications to front-office applications. Secondly, the technical and functional foundations of ES are described. This encompasses main ES issues such as the concepts of integration, configuration and tailoring, and best practices. Thirdly, the chapter depicts the complementary applications and technologies that allow ES to provide companies with a broad functionality. Finally, a discussion of the impact and importance of ES to the IS field, the businesses and the society is presented. A number of concepts, ideas, trends, and concerns already described by several authors are connected to accomplish these chapter's objectives.

2.1 Origins of Enterprise Systems

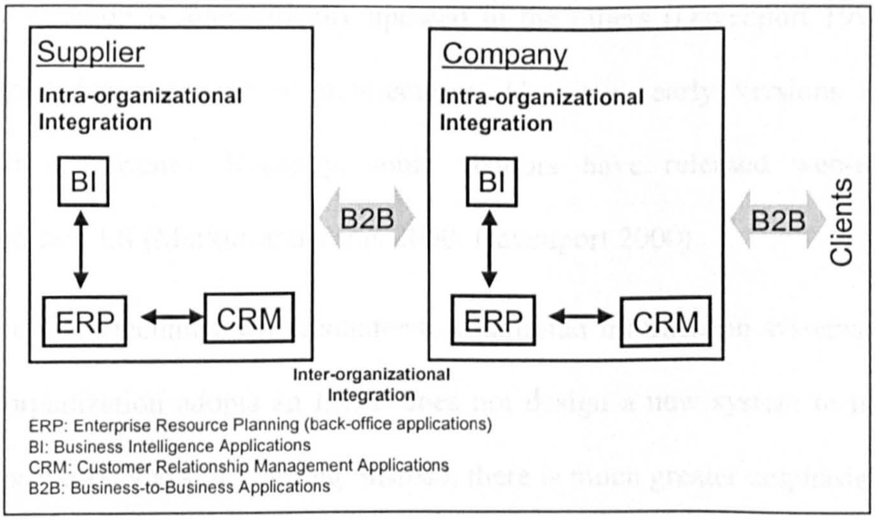
ES are also known as Enterprise Resource Planning (ERP) systems. ERP has its roots in the manufacturing industry (Escalle and Cotteleer 1999; Davenport 2000; Chung and Snyder 2000). A number of authors suggest that ERP is an extension of MRP II with enhanced functionality (Gumaer 1996; Hayes 2002; Yusuf and Little 1998; Chung and Snyder 2000). The name, ERP, is a modification of MRP (Manufacturing Resource Planning), but this relationship between MRP, MRP II and ERP is not just a game of letters and initials. Manufacturing specialists have been always identified as pioneers in organizational integration efforts (Davenport and Short 1990; Ettlie, 1992). The integration of tasks and technologies in the manufacturing processes has been a major objective in manufacturing (Chung and Snyder 2000). The need for this integration led to the development of packaged software. From MRP (Material Requirements Planning) in the seventies, through MRP II in the eighties, to the development of ERP in the nineties, the integration dream has, reportedly, come true (Chung and Snyder 2000). In addition, this evolution has been in a way that the earlier package is included inside the new one. While MRP is the heart of an MRP II, the ERP's manufacturing applications are similar to the MRP II application (Parker 1996; Chung and Snyder 2000).

However, ERP systems go beyond the manufacturing domain. ERP can support thousands of business activities (Markus and Tanis 2000). In addition, although ERP began being "back-office" systems, automating the business transactions, nowadays ERP systems encompass "front-office" applications, supporting supply chain optimisation and customer relationships management (Davenport 2000). Because of this, some authors such as Davenport (2000), Markus and Tanis (2000), and Kawalek and Wood-Harper (2002) refer to ERP systems as Enterprise Systems (ES). As Davenport (2000) argues, "these systems have transcended their origins that the somewhat clumsy ERP name is no longer appropriate." (p. 2). This work agrees with this position. Then, ES is used instead of ERP systems.

The extension of ES beyond the traditional back-office applications is illustrated in Figure 2.1 (Lorenzo 2001b). The extended functionality beyond the traditional ES back-office applications can be provided from either the same ES vendor or third-party provider (see below complementary technologies). Given a value chain for a specific company, Figure 2.1 shows how the ES functionality has been extended into:

- Business intelligence applications (BI), which take data from the ES database for analysing it. These applications include data-warehouse, data-mining, and decision support systems.
- Customer relationship management (CRM) applications, which provide front-office solutions such as sales force automation or call centres.
- Business-to-business (B2B) applications, which allow the company to integrate data and information beyond its own limits (i.e. inter-organizational integration). These applications include solutions such as e-procurement (to place orders to suppliers) and e-commerce (to receive orders from clients).

Figure 2.1 Beyond the transactions-oriented Enterprise Systems



Source: Lorenzo (2001b).

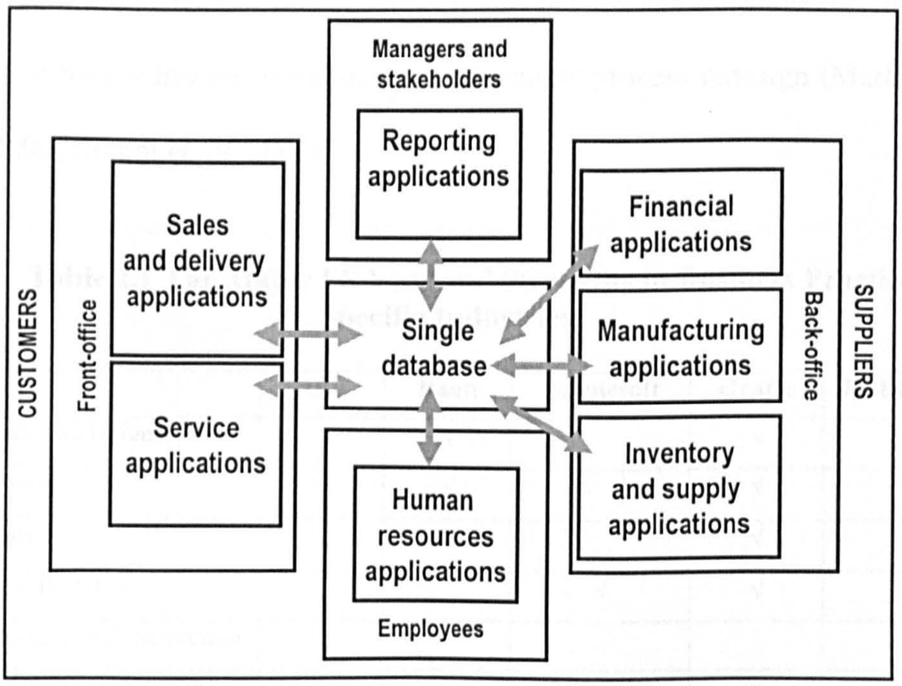
On the other hand, ES have been related to the management philosophy known as business process reengineering (BPR). According to Davenport (2000), ES can be seen as the saviour of reengineering. Davenport argues that one of the major problems in supporting new organizational designs resulting from BPR was to find process-oriented systems. Once ES arrived, they were viewed as "processware." The integration philosophy and work structure of ES mean that they can easily support a process-oriented organizational design, which is the major premise of BPR.

2.2 How do Enterprise Systems work?

ES "enable the integration of transactions-oriented data and business processes throughout an organization" (Markus and Tanis 2000, p. 4). The base of an ES is a single database that receives data from and feeds data into an associated set of modular applications (Figure 2.2). These modular applications support different company functions such as sales, finance, human resources, service, inventory and manufacturing. When new information is entered into a modular application, related information is automatically updated in the others (Davenport 1998). ES are designed for client-server architectures. However, early versions ran on centralized mainframes. Recently, some vendors have released web-enabled versions of their ES (Markus and Tanis 2000; Davenport 2000).

The main technical differentiator to traditional information systems is that when an organization adopts an ES, it does not design a new system to meet its extant or proposed ways of working. Instead, there is much greater emphasis on the organization adapting its business processes to the package's generic functionality. Typically this will involve the reworking of business processes through some degree of business process redesign (Markus & Tanis 2000). Software configuration takes place alongside and in conjunction to this business process redesign. The configuration process ensures that parameters are set in the package to reflect organizational models and business rules (Brehm *et. al.* 2000). Configuration is itself a difficult exercise, requiring that business decisions and their rationale be recorded (Markus and Tanis 2000). It follows that business process redesign and software configuration are key spheres of activity in any ES project.

Figure 2.2 The Anatomy of an Enterprise System



Source: Davenport 1998.

Most of the ES vendors[2] have tried to design their systems to reflect the best-business practices (Davenport 1998). These practices reflect the experiences and suggestions of leading companies (Curran and Keller 1998). They also look to academic theory (e.g. APICS[3]) about the best way to do or manage some types of processes - e.g. production floor or inventory control (Markus and Tanis 2000). ES vendors are sometimes classified according with their strengths in business practices of specific industries (see Table 2.1). SAP's R/3 fits very well to the

[2] See Appendix 1 for a brief description of the major ES vendors
[3] APICS: American Production and Inventory Control Society

personal computer, semiconductor, oil, gas and petrochemical industries (Davenport 1998; 2000). Baan's product has aimed to target the aerospace and defence, transportation, electronics and discrete manufacturing industries (Sullivan 2002; Davenport 2000). Peoplesoft supports very well the health care, education, and government markets (Krill 2002). This concept of best practices is a powerful reason to implement ES without modifying them. But, as aforementioned, when a company wants to realize the benefits of the best practices embedded in these systems, it must carry out some degree of business process redesign (Markus and Tanis 2000; Brehm *et. al.* 2000).

Table 2.1 The Major ES Vendors' Strengths in Business Practices of Specific Industries

Industry	SAP	Baan	Peoplesoft	Oracle	JD Edwards
Aerospace and Defence	√	√		√	
Automotive	√	√		√	√
Chemicals	√			√	√
Consumer Products	√		√	√	√
Engineering and Construction	√				√
Financial Service Provider	√		√	√	√
Healthcare	√		√	√	
Higher Education and Research	√		√	√	
High Tech	√	√	√	√	√
Industrial Equipment and Machinery		√			
Oil and Gas	√			√	√
Retail	√				
Utilities	√		√	√	√

Source: Web-pages from vendors: www.sap.com; www.baan.com; www.peoplesoft.com; www.oracle.com; www.jdedwards.com

Configuring an ES encompasses two sets of decisions (Davenport 1998). First, as most ES are modular, companies have to decide which system's modules or functionalities will be adopted. For instance, almost all companies choose implementing the system in the finance and accounting areas (Knapp and Shin 2001). Second, companies have to set parameters in the package to reflect organizational features (Brehm *et. al.* 2000). This is done through configuration tables. The first task in the customisation process is to establish the basic company parameters - e.g. country settings, tax settings, organizational unit's settings (Prince 1998). Then each configuration team identifies and establishes base parameters that enable the activity of each business process. For example, types of inventory accounting to be used – FIFO or LIFO (Davenport 1998), creating standard reports (Brehm *et. al.* 2000), and formulating available-to-promise logic (Brehm *et. al.* 2000).

It is important to note that field research has shown that some companies have had to modify ES in order to meet specific business needs (Brehm *et. al.* 2000; Light 2001). That is, doing technical adaptation rather than organizational adaptation. This is labelled by Brehm and his colleagues as "tailoring" the enterprise system. This is strongly discouraged by vendors and consultants because tailoring can bring out a number of troubles in different stages of the ES life cycle. Typically, tailoring implies a longer implementation project, a more expensive maintenance, and difficulties in doing upgrading (Brehm *et. al.* 2000; Light 2001). Table 2.2 depicts the typology of ES tailoring types developed by Brehm and his colleagues.

Table 2.2 Typology of ES Tailoring Types

Tailoring Type	Description
Configuration	Setting of parameters (or tables), in order to choose between different executions of processes and functions in the software package
Screen masks	Creating of new screen masks for input and output (soft copy) of data
Workflow programming	Creating of non-standard workflows
Extended reporting	Programming of extended data output and reporting options
User exits	Programming of additional software code in an open interface
ERP Programming	Programming of additional applications, without changing the source code (using the computer language of the vendor, e.g. SAP's ABAP/4)
Interface development	Interfaces to legacy systems or 3rd party products
Package code modification	Changing the source-codes ranging from small change to change whole modules

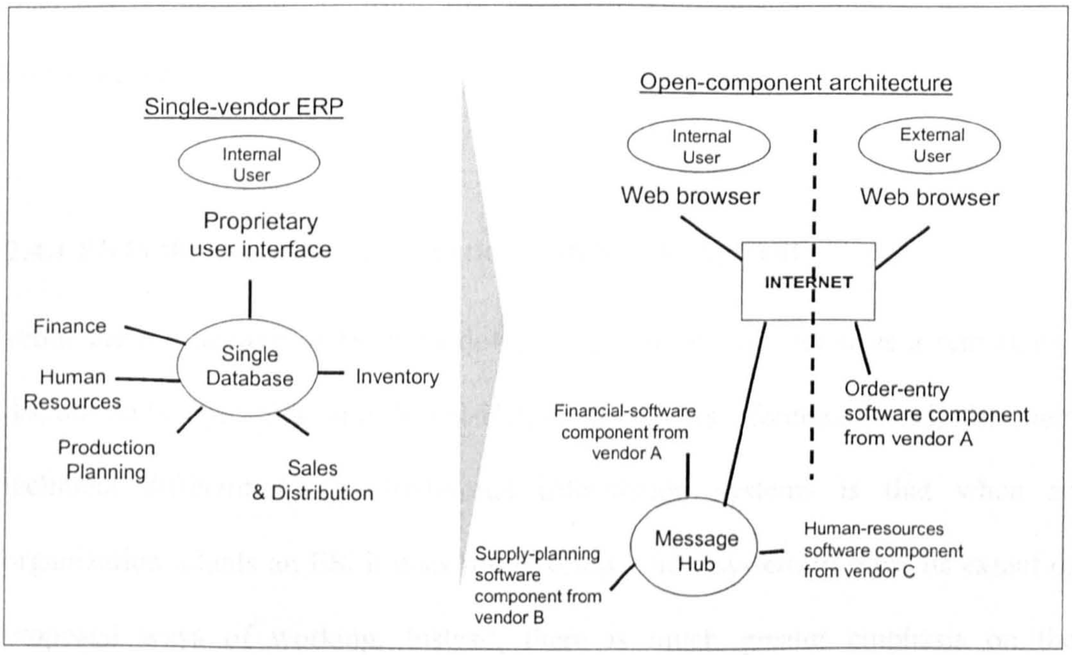
Source: Brehm *et. al.* 2000.

2.3 Complementary Applications and Technologies

Although ES provides companies with a broad functionality, companies often require complementing the ES with further applications (Markus and Tanis 2000; Light *et. al.* 2001). After all, however broad its capability, a single ES does not do it all. As a consequence, bolt-on applications are offered by third-party providers. The bolt-on applications use the ES data and they are able to work in an integrated way with the basic ES package, but it will imply some re-coding in the ES or interface developments by using the ES's workbench tools (Davenport 2000; Prince 1998). The most important types of bolt-on applications to companies seem to be those of supply chain management (SCM), business-to-business (B2B), customer relationship management (CRM), and business intelligence (BI) - (Davenport 2000; James and Wolf 2000). Providers of these systems include i2 and Manugistics for SCM, CommerceOne and Ariba for B2B, and Siebel Systems, Clarify and Trilogy Development for CRM and BI. Given that these capabilities have become sufficiently popular today, the major ES providers (e.g. SAP and Oracle) have extended the functionality of their ES product to compete against these third-party providers in these popular functional areas. In other cases, ES providers have made acquisitions of small third-party providers to incorporate quickly this hot functionality inside their ES products as new functionality (e.g. SAP has acquired shares of companies such as Commerce One).

A second option that companies can use for complementing their ES is the concept of "message brokering" or "middleware" (Davenport 2000; James and Wolf 2000; Markus and Tanis 2000; Posch 1999). Middleware allows disparate applications (either standalone packages or custom-built applications) to communicate through standardized messages. This technology eliminates the requirement that all ERP modules share the same database. This integration approach is more flexible than implementing an ES, but, to date, it has been proven few times. It follows that it is still a risky departure. Some experts agree middleware is a viable alternative to ES when the main objective of a company is to improve software integration rather than improving software functionality (Markus and Tanis 2000). One of the most significant examples of using middleware architecture is that of Dell (Slater 1999). Dell uses middleware architecture to handle finance and manufacturing functions. Figure 2.3 shows graphically both single-vendor ERP and middleware schemes. When middleware is used in conjunction with ES-based information, the resultant platform is called enterprise integration applications (EAI).

Figure 2.3 Middleware creates new choices for ES



Source: James and Wolf 2000.

2.4 The Importance and Impact of Enterprise Systems

ES have been implemented by many companies worldwide. By 1998 about forty percent of companies with annual revenues over $1 billion had implemented an ES (Caldwell and Stein 1998). Small and medium enterprises over the world are also considering and implementing ES (Davenport 2000). Advanced Manufacturing Research (1999) estimates a compound annual growth rate of 32% for the ES market from 1998 to 2003. International Data Corporation predicts that the ES industry will reach almost $25 billion by 2004 (Romeo 2001).

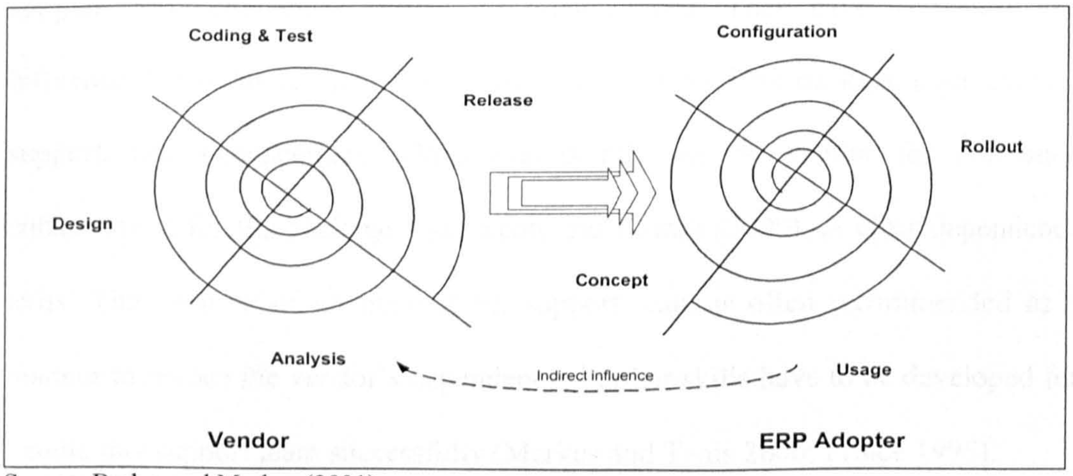
Judging from these indicators and facts, ES can be considered as one of the most important contemporary phenomenon in organizational adoption and use of information technology (Markus and Tanis 2000). Hence, this section attempts to analyse the importance and impact of ES from three different angles: 1) from the perspective of information system methodology, 2) from the perspective of the business value, and 3) from the perspective of the economic and social consequences.

2.4.1 ES in the context of information system development

From the perspective of IS methodology, ES can be considered as a remarkable discontinuity (Kawalek and Wood-Harper 2002). As aforementioned, the main technical differentiator to traditional information systems is that when an organization adopts an ES, it does not develop a new system to meet its extant or proposed ways of working. Instead, there is much greater emphasis on the organization adapting its business processes to the package's generic functionality. With ES the organizational focus is radically different. The organization focuses on configuration instead of development. As a consequence, ES change the Software Life Cycle (SLC) in important ways (Brehm and Markus 2000).

While the traditional SLC consists of activities performed by a company in the aim of developing, implementing and maintaining an IS for its own internal use, the SLC regarding ES separates the model in two sets of activities: adopters' activities and vendors' activities (Brehm and Markus 2000). Brehm and Markus have called it as the "Divided Software Life Cycle Model". The vendor is responsible for the original development of the ES, new releases or upgrading, which include the traditional activities of system analysis, design, coding, and testing (see left spiral in Figure 2.4). The adopter is responsible for evaluating the ES in the concept phase, configuring it, rolling it out throughout the organization and using it (see right spiral in Figure 2.4). Furthermore, there is a continuous flow of feed from the vendor and the adopter (e.g. releasing upgrades or new functionality) and indirect feedback from the adopter to the vendor (e.g. desired bug fixes and enhancements).

Figure 2.4 The Divided Software Life Cycle Model for ES



Source: Brehm and Markus (2001).

The impact of the DSLC on adopters is enormous. At least two major consequences can be described. First, adopters require new skills and roles different to those previously needed and played for a traditional IS development and adoption. In particular, the ES team and users have to develop skills related to 1) mapping organizational requirements, 2) terminology used by the vendor, 3) modelling business processes, and 4) making choices about the parameter configuration (Markus and Tanis 2000; Brehm and Markus 2000; Rosemann *et. al.* 2001). In relation to new roles to be played in an ES project, Kawalek and Wood-Harper (2002) found important evidence related to user-participation. In their language, user-participation in an ES context is related to "the findings of thorns" – i.e. users provide the ES project team with an intelligence function, which allows team learn about local issues in a roll out project into a new site. This role is clearly different to, and more limited than, that played by users in a traditional IS context (e.g. shaping requirements, designing processes and helping set the direction of the IS programme).

Second, a long-term relationship emerges between the ES vendor and the adopter. New challenges appear for organizations. They have to handle and influence this relationship in a way that guarantee to them package maintenance, support, and enhancement. Organizations rely on the vendor for continued enhancement for the package - see Scott and Kaindl (2000). A clear dependence exits. The creation of an internal ES support team is often recommended as a manner to reduce the vendor's dependency. Further skills have to be developed for handle this support team successfully (Markus and Tanis 2000; Prince 1998).

2.4.2 Business Value of Enterprise Systems

ES are able to provide value to the business in different manners. Distinct authors have classified this value through different frameworks (Davenport 2000; James and Wolf 2000; Markus and Tanis 2000). This section describes briefly the ES benefits by grouping them in three key business benefits: 1) tackling IT problems and costs, 2) process efficiency, and 3) organizational effectiveness.

Markus and Tanis (2000) describe how ES can solve many IT problems and costs in an organization. For example, ES have been implemented by some companies in order to 1) solve the Y2K problem, 2) replace hard-to-maintain interfaces, 3) reduce software maintenance, 4) eliminate redundant data entry, 5) improve IT architecture, 6) consolidate multiple different systems of the same type (e.g. general ledger packages).

The ability of ES to integrate data and standardize processes brings many improvements in the organizational efficiency – e.g. faster cycle time, lower back-office staff requirements, reduced inventory, eliminated transactional errors, standardized business language, easier financial consolidation (Markus and Tanis 2000; Davenport 1998 and 2000; James and Wolf 2000; Whorten 2002). A number of examples have been already described in the literature. AutoDesk, a manufacturer of computer-aided design software, reduced its delivery cycle time to customers from two weeks to twenty-four hours. The company also cut its financial closing time from 12 days to six (Davenport 2000). Hoechst Marion Roussel (HMR) reduced its order cycle time from four days to one day. HMR also reduced its inventory by twenty percent as a result of a better planning (Benchmarking Partners 1997b). A recent example is that of Nestle (Worthen 2002). Nestle has saved $325 million by using an ES. The main savings are related to the reduction of inventory and the reduction of distribution expenses. As with HMR, a detailed demand planning is accounted for this huge improvement.

There is also evidence related to improvements in the organizational effectiveness - e.g. improved customer service, supporting the business growth, improved access to better information, laying the groundwork to e-business (Davenport 2000; Lorenzo 1998a; James and Wolf 2002). By using ES and the Internet, some companies have been able to offer self-serve capabilities to customers and supply chain partners. For example, Heineken gives its distributors access to information placed in its ES about product availability and sales options (Davenport 2000). The implementation of an ES in a Latin American Internet Service Provider allowed the company to have the needed technological platform to grow. In less than six months, the company grew from ten thousand customers to more than one hundred thousand customers (Lorenzo 1998a). The use of an ES in HMR has allowed the sales manager to track sales by client, zone, total orders and product group for each month. This resulted in the reorganization of the distribution network. (Benchmarking Partners 1997b). Finally, the ES infrastructure eases the implementation of a range of technologies, which extend and enhance the capabilities of the ES – e.g. sell-side e-commerce, electronic procurement, customer relationship management, and supply chain optimisation (James and Wolf 2000).

2.4.3 Economic and Social Consequences of Enterprise Systems

The broad subject of the economic and social consequences of ES on individual, industries, society and the world has been given little attention. The concern has been briefly considered by Davenport (2000). Davenport (2000) bets on positive economic and social impacts of the ES. He categorizes them into four expected effects: 1) greater productivity in advanced economies, 2) inter-organizational transformations, 3) new basis for competition in industries, and 4) empowered employees. First, given that ES can allow companies to eliminate unneeded inventory, cut time and costs out of core business processes, companies and economies that make broad use of ES may increase their productivity more than those that do not. Second, companies implementing ES are developing the foundations to create closer and more efficient relationships with their customers and suppliers. Then, new forms of organizations and relationships between companies may emerge. Third, as ES are becoming the common technology in every company within specific industries (e.g. energy, automotive, and high-tech), the basis for competition in these industries may change dramatically. According to Davenport (2000), this context can be similar to that of the airline industry in seventies. When every airline had the same basic reservation systems, yield management systems, and frequent-flyer programs, the basis of competition changed into the search of the leadership in costs. Finally, and as a consequence of the first aspect, the improvements in the organizational efficiency may bring out the need for fewer employees. Then, the surviving employees will be those whose have a broader range of new abilities. This learning process will be beneficial for the society, but it will be difficult to accomplish.

2.5 Summary

ES are changing the way as organizations run their business strategies, their business processes and their information systems strategies. ES are allowing companies to reinvent themselves. According to a number of authors and research firms, ES have become the dominant technological infrastructure and the business approach in companies worldwide. This reality may continue for many more years whether the ES vendors continue extending the system functionality to fulfil each of the organizational needs and whether the ES vendors continue resolving the existing system limitations. As a consequence of this, the understanding of the ES as technology and as business approach will continue being important for businesses, and for scholars.

CHAPTER 3: LITERATURE REVIEW

This chapter examines the ES implementation literature and its relation to the IS and innovation fields. In order to structure the argument, the discussion first reviews the main ES topics and areas that have been investigated thus far. A sample of ES works are selected and discussed. Secondly, a comprehensive review of the ES implementation research is presented. As a result of this, a set of research gaps and problems are identified. Then, the chapter suggests the need for looking at the ES implementation from a technological innovation perspective and examines how this perspective has been used in the IS field. Finally, a review of key works from the innovation literature to be applied in the ES implementation problem is presented.

3.1 A General Review of the Enterprise Systems Research

Although ES appeared in the market more than a decade ago, the interest of the IS scholars on ES is recent (Esteves and Pastor 2001a). By matching two previous works, which include a comprehensive literature review of ES (Parr *et. al.* 1999; Esteves and Pastor 2001a), one can see that the first few academic works and investigations on ES were published on 1997 and 1998. Most of them were works presented in conferences such as AMCIS, ICIS, and PACIS[4]. To 2000 there were just published twenty-one works on ES in IS journals[5] (Esteves and Pastor 2001a). After 2000, the number of publications had increased. The interest of the IS community and ES-related areas, such as Supply Chain Management and

---

[4] AMCIS: The Americas Conference on Information Systems
ICIS: The International Conference on Information Systems
PACIS: The Pacific Conference on Information Systems

[5] The journals reviewed by Esteves and Pastor encompassed: ACM, CAIS, DSS, EJIS, HBR, IJIM, ISJ, ISR, JGIM, JIT, and MISQ.

Accounting, was finally growing, which suggested that research and publications also would grow in the next years. The ES topic has been introduced gradually in IS curricula and universities are discussing how ES may affect research in the future (Davenport 2000; Lorenzo and Piñero 2001; Rosemann *et. al.* 2001; Becerra-Fernandez 2000). Furthermore, many universities have created research areas in ES.

In the light of the above, ES can be considered as a novel phenomenon for the IS research and other academic fields, which has opened an immense potential and opportunities for research (Markus and Tanis 2000). This section aims to review a sample of important contributions of the ES works published to date (see Table 3.1). To do this, the selected works have been classified in four key topics: business implications, technical issues, managerial issues, and implementation issues. As ES implementation is the focus of this thesis, the three first topics are discussed in this section and the implementation topic is separately developed in the next section.

Table 3.1 A Sample of ES Research by Main Topics and Areas

ES Topic	Areas of Research	Authors
Business Implications	Strategic and Organizational Implications	Davenport (1998; 2000) Ni and Kawalek (2001) Buckhout *et. al.* (1999) Markus, Tanis & Fenema (2000)
Technical Issues	ES Life Cycle	Brehm and Markus (2000)
	Modelling	Rosemann *et. al.* (2001a; 2001b) Scheer and Habermann (2000) Curran and Keller (1998)
	Configuration and Tailoring	Brehm *et. al* (2000) Light (2001)

ES Topic	Areas of Research	Authors
	Evolving	Markus (2000) Light *et. al.* (2001) Lorenzo (2001b) Scott and Kaindl (2000) James and Wolf (2000) Chung and Snyder (2000) Sproot (2000)
Managerial Issues	Knowledge Creation	Newell *et. al.* (2001) Coulliard (1999) Hislop *et. al.* (2000) Jones (2001) Soh *et. al* (2000)
	User Involvement and User Satisfaction	Kawalek and Wood-Harper (2002) Rodecker and Hess (2001) Nelson and Somers (2001)
	IS Function Role	Willcocks and Styke (2000)
	Vendor/Consultants Management	Volkoff and Sawyer (2001)
	Change Management	Taylor (1998)
	ES and BPR	Soliman and Youssef (1998) Ng *et. al.* (1999) Davenport (2000)
Implementation issues related to adoption, installation project, diffusion, and uses.	Critical Success Factors	Holland and Light (1999) Esteves and Pastor (2001b) Parr *et. al.* (1999) Bancroft *et. al.* (1998) Shanks *et. al.* (2000) Stefanou (1999) Summer (1999) Reinhard and Bergamashi (2001)
	Success Measures	Markus and Tanis (2000) Markus *et. al.* (2000) Smyth (2001)
	Case Studies	Bechmarking Partners (1997a; 1997b) Ross (1999a) Hirt and Swanson (1999) McAfee (1997) Cotteleer (1998) Westerman and Cotteleer (1999) Lorenzo (1998a; 1998b) Brown and Vessey (2001) Bhattacherjee (2000) Whang *et. al.* (1995)
	Long-term requirements and challenges	James and Wolf (2000) Shepherd (2001)

Within the group of pioneer works on ES one in particular to be noted is that published by Davenport in Harvard Business Review called "Putting the Enterprise into the Enterprise System" (1998). In this article, Davenport placed the ES in the context of their impact on the businesses. The author presented evidence of important organizational and strategic implications. Examples described how ES streamline management structure, centralize the control over the information, and standardize business processes. With Davenport also emerged the debate about how ES can impact the companies' competitive advantage. That is, the strategic implications of ES. According to Davenport, companies in which the competitive advantage derives from process differentiation should evaluate cautiously the implementation of ES. Davenport argues that an ES can unify the business practices in a particular industry as a consequence of the implementation of the ES in every company in that industry. In this sense, managers and researchers are asking themselves whether an ES can erode the source of differentiation of a company in a particular market. Davenport's works (1998; 2000) have allowed managers and academics to view the ES phenomenon from a business perspective rather than a technical perspective.

A number of works have also taken the business perspective as their own. Three are herein commented upon. Buckhout, Frey and Nemec (1999) argue that management needs to translate the business strategy and key competitive advantages into factors for the ES implementation. They describe critical business decisions for an ES in a manufacturing environment. In this process, management has to decide what organizational actions and processes will be inside or outside the system. Markus, Tanis and Fenema (2000) identify five different ways to arrange the relationships amongst business units under a multisite ES implementation. They analyse the business implications of each in terms of decision-making autonomy, coordination, decentralization and centralization. Finally, Ni and Kawalek (2001), by looking at a local government authority, provide insights of the impact of an ES on business efficiency, changes of organizational roles, and customer satisfaction. These implications were measured by them under the lens of users' perceptions.

Another topic that has been tackled by researchers is that of technical issues of ES. Four research areas can be identified: 1) life cycle, 2) modelling, 3) configuration and tailoring, and 4) evolving. These areas are discussed in turn:

1. *ES Life Cycle*: The research on the ES life cycle is concerned with the identification and understanding of the similarities and differences between the traditional software life cycle and the ES life cycle. Brehm and Markus (2000) proposed the Divided Software Life Cycle for ES, which represents the activities performed by both the adopter and the vendor. That is, the divided responsibilities (see section 2.4.1: ES in the context of information system development).

2. *Modelling*: The modelling research encompasses aspects such as the use of modelling tools in ES contexts and the identification of business practices approaches. One group of works in this area is that of Rosemann and his colleagues (2001). They have identified the factors that influence process-modelling success through the main phases of the ES life-cycle (e.g. modelling methodology, modelling tools, modeller's expertise, and user participation). Sheer and Habermann (2000) have proposed an ES implementation strategy based on business process models. They suggest a direct interaction between the modelling tool (e.g. ARIS), the reference models included within the ES

(e.g. using the Baan's Dynamic Enterprise Modelling – DEM), and the application. This results in parameter decisions and unresolved issues. Once it is documented, knowledge management is enabled for continuous process improvement.

3. *Configuration and Tailoring*: As mentioned before, configuration refers to setting parameters in the ES in a way that the company follows the system's precepts. However, many companies have modified ES in different ways to meet their specific business needs. In this case, the system is modified to follow the company's needs. Then, some ES works have developed frameworks to categorize the configuration and modification options. Brehm and his colleagues (2000) proposed a framework named as Typology of Tailoring Options (see Table 2.2). In addition, works in this area have also assessed the impact of the different types of tailoring on future maintenance and post-implementation activities (Brehm *et. al.* 2000; Light 2001).

4. *Evolving*: There are a number of ES studies related to that called by Markus and Tanis (2000) as "evolving." Evolving encompasses aspects such as enhancing functionality in an ES, componentisation, increased flexibility, and introduction of complementary applications and technologies. Scott and Kaindl (2000) provide a theoretical explanation of how an ES vendor enhanced the financial functionality (the treasury module) for the US market with the aid of customers. Some works (Markus 2000; Lorenzo 2001b; James and Wolf 2000; Light *et. al.* 2001) look at the extension of ES beyond the traditional back-office applications (see Figure 2.1) and the use of alternative architectures (e.g. best of breed and middleware – see section 2.4). Chung and Snyder (2000) review the technological evolution of ES and argue that the development of an

integrative value chain relies on the adoption of an ES. Sproot (2000) attempts to foresee how the componentisation of ES will evolve.

ES projects are "managerially challenging" (Markus and Tanis 2000). The research around this concern encompasses the following areas: 1) knowledge creation, 2) user involvement and user satisfaction, 3) IS function role, 4) vendor/consultants management, 5) change management; 6) ES in the context of a business process redesign initiative. They are explained in turn:

1. *Knowledge creation*: ES can be considered as the most knowledge-intensive project an organization can undertake (Coulliard *et. al.* 1999). Because of this, a number of researchers have focused on studying the process of sharing, acquiring and transferring knowledge in the context of an ES implementation. Coulliard and his colleagues (1999) identify a set of knowledge transfer activities occurring in each phase of the SAP implementation. Hislop, Newell, Scarborough and Swan (2000), examine how the political process affects the appropriation of IT-based innovations in an ES environment. Later, by examining a case study in UK, Newell, Tansley and Huang (2001) demonstrate the paradoxical effects of the project team's social capital to access necessary knowledge for the system design. Jones (2001) has studied the factors that enable companies to integrate the diversity of knowledge required to make effective use of ES. Soh and her colleagues (2000) have also recognized the difficulty behind the integration of the knowledge in ES implementation. They suggest that key-users have the bigger role in the knowledge acquisition challenge.

2. *The Role of user satisfaction and user involvement*: Recent ES research has applied the end user computing satisfaction (EUCS) instrument widely used in

IS research to measure ES success from the end-user's perspective (Rodecker and Hess 2001; Nelson and Somers 2001). Kawalek and Wood-Harper (2002) have also recognized the importance of user-participation in an ES project. They suggest that user participation can be deployed to serve the interests of the project team in reporting local circumstances as the implementation project moves across different sites. They have called it the users' intelligence function.

3. *IS function role*: This has been one of the neglected research areas in the ES context. As an extension of their previous IS works, Willcocks and Styke (2000) identify key in-house IT capabilities required to enter into ES projects. The capabilities are: IT leadership, business systems thinking, relationship building, technology fixing, informed buying, contract facilitation, contract monitoring and supplier development.

4. *Vendor/consultants management*: When an organization implements an ES, it enters into risky long tem relationship with the software vendor (Markus and Tanis 2000). In addition, companies have to contract consultants to reduce knowledge barriers (Volkoff and Sawyer 2001; Attewell 1992). Then, the vendor/consultant management has become a key concern in companies implementing ES. There is few works tackling this concern. A recent one is that of Volkoff and Sawyer (2001), whose build a model of collaboration between project teams and ES consultants.

5. *Change management*: Given the huge business implications of ES on organizations, change management has become a key managerial challenge to guarantee the ES success. Although some case studies describe how companies have managed the change (Benchmarking Partners 1997a, 1997b), few works

have developed models to guide the change management in an ES context. An exception is the Taylor's approach (1998). Taylor used the socio-technical systems (STS) theory to propose a method of implementing ES. Amongst the benefits of his method is the motivational improvement of local participation.

6. *ES and Business Process Redesign (BPR)*: A number of works have focused on the implementation of ES under an enterprise re-engineering (BPR) context. Ng and her colleagues (1999) propose a conceptual model to implement ES in a BPR context. Davenport (2000) argues that ES can be considered as "processware." As a consequence, organizations are using new approaches to process change (Soliman and Youssef 1998; Davenport 2000). One of them is that of Davenport called "ES-enabled reengineering." This approach consists of reconciling the process the company wants with what the ES models allow the company to do.

3.2 A Discussion of the Enterprise Systems Implementation Research

The ES implementation is a complex voyage with high chances of failure. In fact, many implementations of these systems have become a nightmare. The ES literature reveals that many implementations of these systems have failed in the project phase (Buckhout *et. al.* 1999; Scott 1999; Davenport 1998), or have failed to diffuse and incorporate the system throughout the organization's operations and activities (Shepherd 2001; James & Wolf 2000; Gilbert 1999), or have failed to reach the expected business benefits after the system has gone live (Shepherd 2001; Markus and Tanis 2000; Davenport 1998).

The number of publications that are related to implementation process is greater than the number related to other issues (Esteves and Pastor 2001a). The ES implementation research can be categorized into four main topics. A first group of publications falls into the investigation of the critical success factors (CSF). A second group is related to how to measure success throughout the implementation stages. A third set of studies is based on descriptive case studies. A final recent group of works is concerned with the implementation's long-term requirements and challenges. (see Table 3.1).

3.2.1 Factors Research Stream

The factors research stream is concerned with the identification of factors that influence on the success or failure of the ES implementation. The most ES studies follow the factors research stream. A variety of variables have been identified and examined as being important to the different implementation stages. The results are relatively consistent given that a group of factors reappear in different works. Table 3.2 depicts the factors appearing in five selected works. The most recurrent factors are: top management support (Holland and Light 1998; Reinhard and Bergamashi 2001; Esteves and Pastor 2001b; Parr *et. al.* 1998; Bancroft 1998), project schedule and plan (Holland and Light 1998; Reinhard and Bergamashi 2001; Esteves and Pastor 2001; Parr *et. al.* 1998), and communication (Holland and Light 1998; Reinhard and Bergamashi 2001; Esteves and Pastor 2001; Bancroft 1998).

Critical success factors research has been quite well covered in the ES context (Esteves and Pastor 2001b). However, specific needs have not been fully fulfilled yet. First, there is the need for identifying the CSF for each implementation stage and for different implementation strategies. Two recent works can be mentioned. Esteves and Pastor (2001b) categorized the CSF along the SAP implementation phases. Reinhard and Bergamashi (2001) identified the CSF for each project phase. This type of works will bring about an important guideline for practitioners and managers. Second, there is the need to develop approaches to manage, control and monitor the CSF (Esteves and Pastor 2001b).

Table 3.2 A Sample of Critical Success Factors for the ES Implementation by Authors

Factors	**Holland and Light (1999)**	**Parr *et. al.* (1999)**	**Esteves and Pastor (2001b)**	**Bancroft (1998)**	**Reinhard and Bergamashi (2001)**
Business Vision	√				√
Top Management Support	√	√	√	√	√
Implementation Strategy	√		√	√	
Project Schedule and Plan	√	√	√		√
Communication	√		√	√	√
Adequate software configuration	√		√		
Monitoring and feedback	√				
Empowered decision makers		√	√		
Best people full time		√	√	√	
A Champion		√	√	√	
Avoid customisation	√	√	√		
Commitment to change				√	
Adequate training programme			√		
Adequate consultants			√		√

3.2.2 Success Measures Research Stream

This research stream is concerned with how to measure success or failure in each phase of the ES life cycle. The major works are those of Markus and her colleagues (2000). They have modelled the ES experience and the dynamics of ES success by using a framework that has been called as the Enterprise Systems Experience Cycle (ESEC). They have modelled the ESEC framework by following emergent process theories (Soh and Markus 1995; Orlikowski and Robey 1991). For them, ES can be described as moving through several phases, characterized by key players, typical activities, characteristics problems, performance metrics and a range of possible outcomes. Hence, each enterprise systems experience is unique. They also explain that there are factors which impacts on the outcomes in each phase, which become inputs in the next phase. Under this view, early success can be followed by failure or vice versa.

The ESEC framework consists of four phases: chartering, project, shakedown, and the onward and upward phase. The chartering phase comprises decisions leading up the funding of an ES. The project phase consists of activities intended to get the system up and running in one or more organizational units. The shakedown phase is the period of time from 'going live' until 'normal operation' has been achieved. Finally, the onward and upward phase continues from normal operation until the system is replaced with an upgrade or a different system. Table 3.3 shows the success metrics for the ESEC phases.

Markus and her colleagues chose the emergent process theories to model the ES experience and success because these theories combine goals and actions with external forces and chance. This is the strength of these theories. That is, to capture the mutual influences between the organization and its environment. However, the weaknesses of these theories, and consequently of the ESEC framework, are 1) the explanatory power rather than predictive, and 2) the significant role assigned to chance. Both reasons become weaknesses because practitioners and managers prefer prescriptive models (Markus and Tanis 2000).

Table 3.3 Success Metrics for the ESEC Phases

Phase	Success Metrics
Chartering	Quality of business case Fit with business strategy Adequacy of schedule and budget
Project	Project cost relative to budget Project completion time relative to schedule Completed and installed system functionality relative to original project scope
Shakedown	Short-term changes occurring after system 'go live" in key business performance indicators such as operating labour costs. Length of time before key performance indicators achieve expected levels. Short-term impacts on the organization's adopters, suppliers and customers such as average time on hold when placing a telephone order
Onward and Upward	Achievement of business results expected for the ES project, such as reduced IT operating costs and reduced inventory carrying costs. Ongoing improvements in business results after the expected results have been achieved. Ease in adopting new ES releases, other new ITs, improved business practices, improved decision making, etc., after the ES has achieved stable operations.

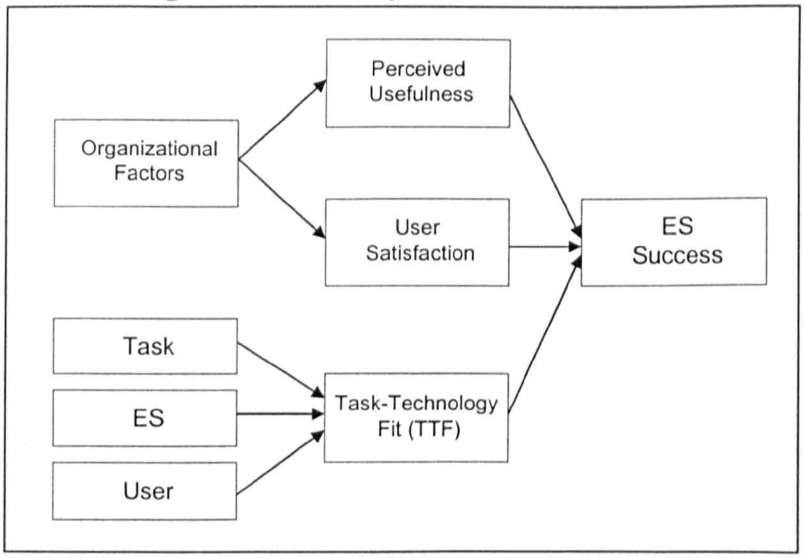
Source: Markus and Tanis (2000); Markus *et. al.* (2000)

Smyth (2001) has also contributed in the debate of how to measure ES implementation success. To do this, Smyth has developed an ES Success Model based on a framework used to explain success in the adoption of CASE packages (Smyth 1999). The model is shown in Figure 3.1. The model incorporates three related indicators which all together affect on the ES success: 1) the Task-Technology Fit (TTF) construct developed by Goodhue and Thompson (1995), 2) the perceived usefulness construct described by Ives and Olson (1984), and 3) the user satisfaction indicator as reported by DeLone and McLean (1992). Smyth used the comparative case study method and took into account theory from related fields. This is valuable for research in the way that researchers might test the model by adding further sites.

3.2.3 Descriptive Case Studies

Perhaps descriptive case studies are the largest category of works (Esteves and Pastor 2001a). Different issues have been covered such as adoption of ES (Hirt and Swanson 1999), ES implementation (Cotteleer 1998; Bhattacherjee 2000; Lorenzo 1998a, 1998b; Benchmarking Partners 1997a, 1997b), global ES implementation (Westerman and Cotteleer 1999), ES implementation in a BPR context (Ross 1999), and ES uses in a manufacturing context (Whang *et. al.* 1995). Most of them is concentrated on the description of the real implementation of an ES in a particular context. There is a lack of assumptions or hypotheses for future studies and a lack of explanation of research methodology. Then, the theoretical contribution of these case studies has been slight.

Figure 3.1 The Smyth's ES Success Model



Source: Smyth (2001)

3.2.4 Long-term Requirements and Challenges

After most large industrial companies have installed ES, the managerial concern is moving to the long-term ES requirements and challenges related to maintenance, support, continuous improvement and changes, continuous training, continuous learning, spreading the systems throughout the company beyond first installation, using the system to its complete potential, and realizing the expected benefits (Shepherd 2001; Light 2001; Brehm *et. al.* 2000; Davenport 2000; James & Wolf 2000). Although these activities can be considered as part of the post-implementation phases, they are tightly connected to the way as the initial implementation phases were carried out (Markus *et. al.* 2000). For instance, how extensively the ES was assimilated over initial implementation stages in order to support continuous improvement and the deployment to further departments and locations (Markus and Tanis 2000). These types of concerns have resulted in that organizations are revisiting the business case for ES (James and Wolf 2000).

An interesting subject related to the assimilation of the ES is looking at the implementation as a learning process. The ES implementation success metrics should include indicators of organizational learning (Markus *et. al.* 2000). However, little attention has been given to this concern. By looking at the ES literature, key learning challenges can be derived. There such challenges are presented below:

1. Learning about skills for carrying out ES implementation activities. In the terms given by Kim (1993), this refers to abilities for producing action (know-how). This encompasses skills such as modelling business processes, configuring and tailoring the system, training end-users, using the system, and rolling out the system to other locations (for an ES context see Rosemann *et. al.* 2001).

2. Learning about an organization's own business processes and the business practices embedded in the ES. Users do not necessarily fully understand the

business processes constructed around their own functions. A major learning challenge in designing and modelling business processes is to understand (know-why) how the organization actually runs its processes and what its needs are. At the same time, as the ES project moves onward, users have to learn about ES functionality. It follows that the implementation process requires both comprehensive understanding of the organizational needs and detailed knowledge of a complex system (Soh *et. al.* 2000).

3. Learning about the ES integration philosophy. Since cross-functional integration is still a new concept to many organizations (Markus *et. al.* 2000), users can effectively understand and apply (know-why) this concept only after working thorough several learning cycles. Without a clear understanding of the integration concept, diffusion occurs slowly and ineffectively. In fact, failure to completely understand how ES affect business processes appears to be responsible for many failure ES implementations (Crowley 1999).

Then, long-term requirements and challenges are new concerns that require more attention from scholars and specialists. Mainly, it is the research firms (e.g. AMR Research) that are considering the topic in depth. AMR's report, signed by Shepherd (2001), proposes the following important missions to support the long-term ES requirements and challenges in organizations: 1) continue the deployment of the ES to additional departments, divisions, and locations, 2) reconfigure and enhance the applications to support changing business processes and organization structures, 3) provide continuing education and training for existing and new employees, 4) monitor new releases and add-on products and evaluate their potential benefit to company, 5) coordinate internal and external technical support resources, 6) plan and manage the rollout of periodic release upgrades. For

Shepherd (2001), these activities should be part of a full-time function and it should not be part of the IT function. This new function might be also responsible for business process design and maintenance.

3.2.5 Summary of the ES Implementation Research

In the light of the above evidence it is plausible to claim that the ES implementation research is a novel research field with a huge potential and opportunities. In its short life, considerable progress and important findings have occurred. Most of the existing research has borrowed models, theories and constructs from the IS implementation research (e.g. factors research, emergent process theories, and task-technology fit). This has allowed ES implementation research to evolve quickly. However, our understanding of ES implementation is yet incomplete. Some criticisms are as follows:

- There is not a consistent definition of ES implementation. Implementation does not seem to have the same interpretation for everyone. In many cases implementation is considered as constituted just by the project stage. In addition, another authors have their own model of implementation stages.
- The ES implementation research remains fragmented with most studies following the factors research stream and descriptive case studies. In addition, some works are focused on a single stage or phase of the implementation process (e.g. mainly the project phase).
- Little research attempts to generalize the findings. In fact, most of the research works are focused on just one ES provider (e.g. SAP).

- Few works have considered the long-term requirements and challenges around the ES implementation. (e.g. new larger issues related to diffusion, learning, continuous improvements, and infusion of the ES throughout a company). It is not yet known, for example, how widely these technologies have been diffused and assimilated in organizations, how learning process occurs, how extensively they are used inside organizations, or how effectively they are used.

3.3 A Technological Innovation Perspective for the ES Implementation Research

Given the problems described above, there is a need for defining the implementation process beyond the installation and project stages and there is a need for integrating the long-term requirements and challenges (e.g. continuous improvement and learning) into the implementation definition. To fulfill these needs one can borrow the perspective of organizational introduction of a technological innovation from the innovation discipline (Rogers 1995; Kwon & Zmud 1987; Kimberly 1981; Leonard-Barton 1988).

Firstly, under a technological innovation perspective diffusion and use of the technology are part of the implementation issue. Different authors represent distinct stages in the implementation of a technological innovation, but all of them seem to agree that the implementation process finishes when the usage of the technology is encouraged as a normal activity - i.e. routinizing or infusion (Rogers 1995; Coopers and Zmud 1990; Kimberly 1981). For Kimberly (1981), the theoretical issue under this perspective is understanding why and how an innovation spreads inside an organization, that is its internal diffusion beyond the installation project. He states clearly the problem when concludes: "...adoption, implementation and use of an innovation in one organizational subunit does not lead naturally and inevitably to widespread use throughout an organization" (Kimberly 1981, p. 91).

In addition, the technological innovation perspective also considers long-term requirements and challenges that have to be faced by organizations when introducing an innovation. For instance, Rogers (1995) talks about the clarifying stage. That is, arrangements and corrective actions that are made for the innovation in order to eliminate misunderstanding or unwanted side-effects that were originate in the initial stages. This problem-solving process is described by another authors as a vital part of the innovation process (Argyris 1992; Leonard-Barton 1995). Taking corrective actions on the innovation being implemented rely on a cycle of action-outcome-feedback carried out by the individuals in the organization. By doing the implementation process under this perspective organizations are more likely to reap lasting benefits (Leonard-Barton 1995).

The technological innovation perspective has been used in the implementation of other kinds of information systems (Cooper and Zmud, 1990; Kwon and Zmud, 1987; Sullivan 1985). For Kwon and Zmud (1987) information systems implementation can be defined as an organization effort to diffuse an appropriate IT within a user community. They have developed an IT implementation research model, which is based on the organizational change, innovation, and technological diffusion literature. Afterwards Cooper and Zmud (1990) used this model to study the implementation of production and inventory control information systems. On the other hand, Sullivan (1985) studied the relationships between the extent of diffusion and infusion of information systems and the distinct practices of information systems planning. The special characteristics of ES explained above re-motivate an enquiry into this topic. Given its sheer scale and its standardized functionality, the processes of diffusion and infusion might be quite distinctive. This is a broader perspective upon ES implementation, and relates to the earlier body of IS research (Cooper and Zmud, 1990; Kwon and Zmud 1987).

3.4 A Review of the Technological Innovation Perspective in the IS field

While the organizational introduction of a technological innovation is a subject that has been widely studied by social scholars, little research has been carried out to extend this perspective to the IS context. Few IS works can be identified as considering IS from an innovation perspective – i.e. IS innovation (Swanson 1994). In order to structure the discussion of these works, this section is divided into four segments, which correspond to four different IS innovation topics considered in the IS literature. They are as follows:

1. Types of IS innovations
2. Knowledge barriers of IS innovations
3. IS Implementation as a Technological Innovation
4. The IS function to support IS innovations

3.4.1 Types of IS Innovations

Swanson (1994) argues that the innovation theory offers an especially promising route for the understanding of the IS phenomenon. However, innovation theory has been selectively applied in IS contexts. In fact, no theory of IS innovation is distinguishable from organizational innovation theory. Then, Swanson attempted to suggest some needed foundations related to how to map IS innovations. To do this, she borrowed an organizational innovation model from Daft (1982). IS innovations are posited to be of three types:

- Type I is defined as process innovation confined to the functional IS core. For example, IS innovations focus upon the IS administrative task or centered on the technical IS task.
- Type II applies IS to the administrative core of the host organization business. For instance, automated financial accounting systems, and payroll and personnel record systems. Core business technology for the production of the organization's goods and services is not part of this classification.
- Type III integrates IS with core business technology and may impact upon the administration function as well. This type of innovation may be strategic, in terms of offering competitive advantage. For example, the introduction of material requirements planning (MRP) in the 1950s, or the introduction of airlines and other real-time reservation systems in the 1960s (e.g. the case of SABRE by American Airlines).

Swanson argues that IS innovations can be hybrids of these types. By applying the Swanson's typology to ES, one can argue that ES can be a hybrid of two or three types. For example, most of ES vendors offer functionality related to:

financial accounting (type II), human resources (type II), and manufacturing (type III). But specific ES providers (e.g. Baan) offer a service functionality that might be used in the IS administrative tasks (type I). Finally, The Swanson's work also addresses the contextual structure for IS innovation diffusion amongst organizations and include a variety of propositions about the pattern of IS innovation adoption, diffusion and evolution.

3.4.2 Knowledge Barriers of IS Innovations

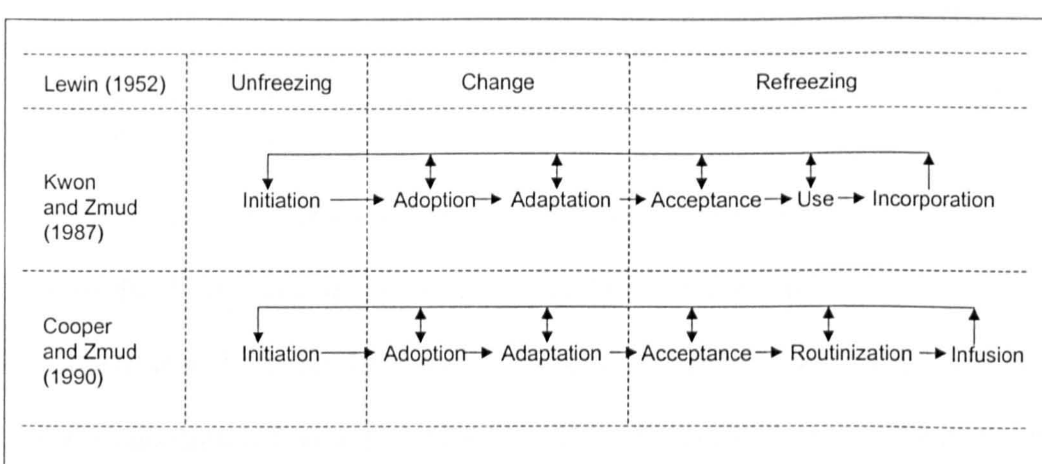
By studying business computing in the United States, Attewell (1992) re-conceptualize the diffusion of technology in terms of organizational learning, skill development, and knowledge barriers. Two claims are the centre of the Attewell's framework: 1) knowledge and technical know-how become important barriers to technology diffusion, and 2) to reduce these barriers, supply-side institutions have to innovate in the development of mechanisms for reducing this knowledge and learning burden upon end-users. Attewell criticizes two traditional assumptions and departs his work in important respects. Firstly, Attewell agrees with the Brown's (1981) critiques to the assumption that every organization has an equal opportunity to adopt, limited only by their "innovativeness." On the contrary, Attewell takes the assumption that institutions that supply innovations affect the spread of innovations, and determine in some degree who adopts and when. Secondly, Attewell differs from most studies of supply-side institutions in looking at the diffusion process in terms of knowledge transfer. On the contrary, Attewell considers that organizations absorb new complex technology through learning by doing. End users spend several years developing and understanding of the strengths and weaknesses of the technology. Then, learning by doing is not the result of knowledge transfer from the originator to the user of the technology. His point is the opposite: the need for learning and skill formation *in situ*, far from the originator.

3.4.3 IS Implementation as a Technological Innovation

To my knowledge, the Zmud and his colleagues' works (Zmud and Apple 1989; Kwon and Zmud 1987; Cooper and Zmud 1990) are the only ones which have modelled the IS implementation process by taking concepts and models from the technological innovation theories (Lewin 1952; Rogers 1995). By viewing from the technological innovation perspective, Zmud and his colleagues define IT implementation as an organizational effort directed toward diffusing appropriate IT within a user community. Initially, Kwon and Zmud (1987) proposed a stage model of IT implementation activities founded on Lewin's (1952) three-stages change model: unfreezing, change, and refreezing (see Figure 3.2). Later, Cooper and Zmud (1990) developed a variation of the initial model to incorporate some post-adoption behaviours found by Zmud and Apple (1989). The model also proposes feedback loops, which may act in positive or negative manners. Positive feedback results in the full incorporation of an IT, whilst negative feedback would result in 'exnovation.' – see Figure 3.2. Each stage is described in Table 3.4. Kwon and Zmud (1987) also identified five major contextual factors, which influence each of the six phases. These contextual factors relate to characteristics of the user community, characteristics of the organization, characteristics of the technology being adopted, characteristics of the task to which the technology is being applied, and characteristics of the organizational environment.

The model was applied by Cooper and Zmud (1990) to study the implementation of a production and inventory control information system (material requirements planning: MRP). They studied the effect of two contextual factors (technology and task characteristics) on two IT implementation stages (adoption and infusion). The study brought as conclusions that task-technology compatibility is a major factor in explaining MRP adoption behaviours, but task-technology does not seem to significantly affect MRP infusion. One of the limitations of this study described by the authors has been that the data was collected by one-time cross-sectional telephone survey. This suggests that conclusions that consider a time component must be made very tentatively. For instance, as infusion of technological innovations tends to be time dependent (Zmud and Apple 1989), the conclusion that task-technology does not affect MRP infusion should be taken prudently.

Figure 3.2 A Model of IT Implementation Process



Source: Zmud and Apple (1989); Kwon and Zmud (1987); and Cooper and Zmud (1990)

More recently, Winston and Dologite (1999) have also applied the Cooper and Zmud's model to identify the key factors that affect on the infusion stage in a small businesses context. They classified the factors in four categories:

organizational, end-user, owner, and extra-organizational situation. A critic to this study is that the infusion construct is not clearly operationalized. Then, it is difficult to notice the dependency between some of the factors with the infusion result. Perhaps, this was thought in this way to facilitate the identification of possible relationships from the secondary data, which is a limitation of the study.

Table 3.4 The Cooper and Zmud's Six-Phase IT Implementation Model

Phase	Definition	
Initiation	Process	Scanning of organizational problems/opportunities and IT solutions.
	Product	A match is found between an IT solution and its use in the organization
Adoption	Process	Getting organizational backing for the implementation of the IT application
	Product	A decision is reached to invest resources in the implementation effort
Adaptation	Process	The IT application is developed, installed, and maintained.
	Product	The IT application is available for use in the organization.
Acceptance	Process	Inducing the organizational members to use the IT application.
	Product	The IT application is employed in the organizational work.
Routinization	Process	Usage of the IT application is encouraged as a normal activity.
	Product	The IT application is not longer perceived as something out of ordinary.
Infusion	Process	Increasing the organizational effectiveness by using the IT application in a more comprehensive and integrated manner to support higher levels aspects of organizational work.
	Product	The IT application is used to its fullest potential.

Source: Adapted from Cooper and Zmud (1990)

Finally, it is worth noting some limitations of this technological innovation view of the IS implementation (Allen 2000). One of them is methodological, which is concerned with 1) the definition of technology characteristics that allow cross-study comparisons (Tornatzky and Klein 1982; Wolfe 1994), and 2) the difficulties of remembering past adoption decisions accurately. Another limitation refers to the approach's conceptual assumptions. The technological innovation approach assumes that the innovation is positive for the organization. As a consequence, poor adoption occurs as a result of the deficiencies or faults of adopting organizations.

3.4.4 The Managerial Challenges to Support IS Innovations

This set of works is concerned with:

- Restructuring the IS function to manage the introduction of IS innovation, and
- Developing implementation strategies to introduce IS innovation.

In relation to the first concern, Agarwal, Krudys, and Tanniru (1997) addressed what they perceived to be a very critical problem: *how to make the IS unit more flexible and adaptive to continually seek to improve its performance*? They found the answer by looking at the innovation literature: the IS unit must become to be a learning-oriented organization. Their framework encompasses three strategies to infuse learning in an IS organization: create the context for a goal-directed learning, facilitate the individual learning, and enable the leader's role in creating a culture of learning. The authors formulated their framework from prior theoretical and empirical work in individual and organizational learning. A case study illustrated how the framework works and provided field-based insights.

El Sawy (1985) proposes an approach for managing the introduction of IT. He calls it as implementation by cultural infusion. The aim behind this approach is to facilitate the diffusion of an IT throughout the organization and to manage the implementation of IT that are continuously multiplying and changing. The implementation by cultural infusion consists of three stages: matching, cultural infusion, and inside-out diffusion. Matching is concerned with scanning the external technological environment and investigates potential user needs until a match is achieved. Once the IT is identified, a user group is chosen on the basis of the previous stage. The cultural infusion process involves two aspects: infusing the application into the core group's work activities and using cultural values (e.g. user sophistication in the use of an application is not a one-shot process) as a means of facilitating and sustaining the infusion. Finally, the culture of the new application is diffused from the core group outwards to the secondary users. The El Sawy's approach was formulated from a single case study in a small organization. Hence, the model might not be transferable to larger organizations. The model could be different in the mode of interaction between the internal organizational roles. However, the model brought valuable insights in terms of how organizations manage the introduction of an IS innovation.

3.5 A Review of the Technological Innovation Perspective in the Innovation Literature

The research related to the implementation of technological innovation within organizations has been very fruitful. This literature has addressed different issues such as the innovation process (Rogers 1995; Voss 1994), adaptation between technology and organization (Leonard-Barton 1988), innovative capabilities (Rogers 1995; Cohen and Levinthal 1990), problem-solving process (Argyris 1992; Leonard-Barton 1995), internal diffusion (Kimberly 1981), rate of adoption (Rogers 1995; Kimberly 1981), adopter categories (Rogers 1995), life cycles of innovations in organizations (Kimberly 1981), characteristics of the learning companies (Pedler *et. al.* 1991; Garvin 1993), innovation characteristics and innovation implementation (Tornatzky and Klein 1982), managerial challenges (Bessant 1993; Van de Ven, 1986), organizational learning (Argyris and Schon 1978; Argyris 1992; Senge 1990), experiential learning (Kolb 1984; Kim 1993). This section aims to review just those works that underlies key concepts to be applied in the ES implementation, as studied in this research: 1) the innovation process and 2) the experiential learning and the problem-solving process.

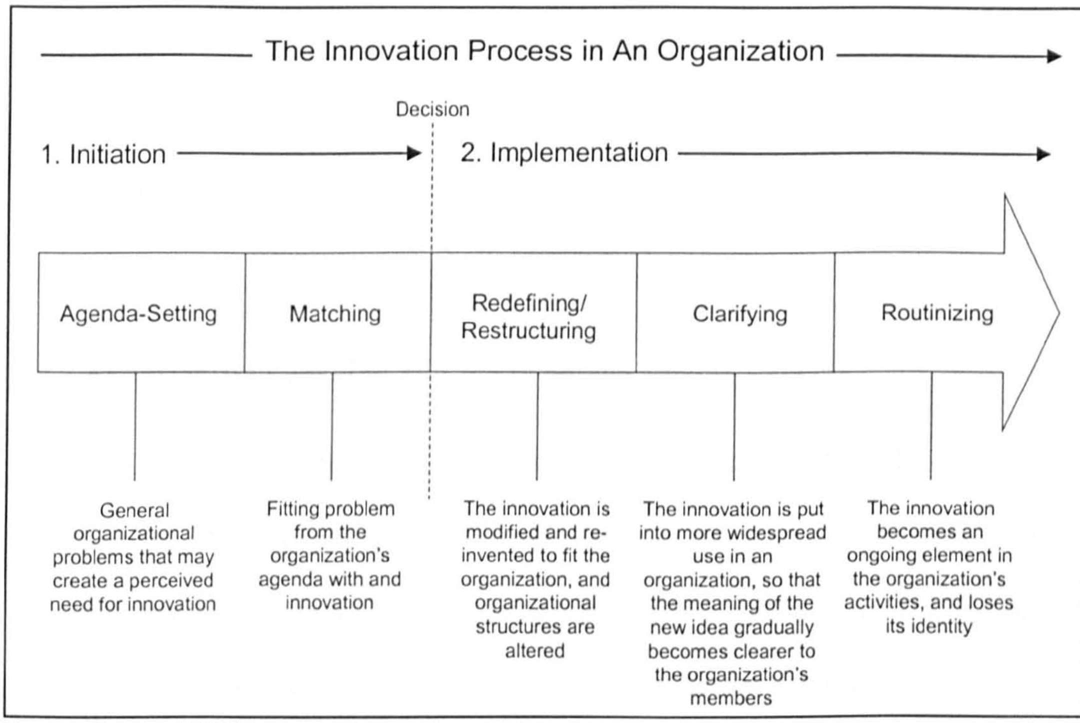
3.5.1 The Innovation Process within Organizations

Two different perspectives have been used to analyse innovation: 1) the adoption perspective and 2) the implementation, diffusion and use perspective (Rogers 1995, Kimberly 1981). The former perspective is concerned with the understanding of what makes an organization responsive to change in its environment. The latter perspective asks how an innovation should be designed, implemented and marketed to enhance rapid and widespread acceptance. This has resulted in that the innovation process is composed of two sub-processes (Rogers 1995): initiation process and the implementation process (see Figure 3.3). The initiation process is concerned with the actions and events leading up to the decision to adopt. The implementation process is concerned with the actions and events involved in putting an innovation into use. Figure 3.3 describes the two stages that form the initiation sub-process and the three stages that constitute the implementation sub-process. Then, under an innovation perspective, internal diffusion and widespread use of the technology are part of the implementation process.

Two assumptions and biases can be identified for the innovation and diffusion research (Rogers 1995; Kimberly 1981). They are briefly discussed below:

- Pro-innovation bias: The assumption of the most research that an innovation should be adopted and diffused by all members of a social system. Kimberly describes this assumption as "adoption of innovations is good and not adopting them is bad." (p. 87). This bias leads researchers to ignore important issues such as the rejection, discontinuance, and reinvention of innovations.

Figure 3.3 The Rogers' Innovation Process



Source: Rogers (1983)

- The individual-blame bias: The tendency to hold an individual responsible for her problems rather than the system in which the individual is part (Caplan and Nelson 1981). In an organizational view, this bias can be read as poor adoption occurs as a result of the deficiencies or faults of adopting organizations. Rogers argues that one of the reasons of this bias is a result of who sponsors the research. That is, research tends to side with the agencies that promote innovations.

On the other hand, some methodological problems can be also identified from the innovation literature. One of them is the recall problem. As an innovation diffuses through time, the reconstruction of the past history creates a methodological problem. The research design consists mainly of correlational analysis of cross-sectional data gathered in one-shot surveys of respondents (Rogers 1995). This is a convenient methodology for researchers but it is inappropriate to capture the processual issues of the innovation process (Pettigrew 1990; Rogers 1995). A more appropriate design to reflect the time dimension is longitudinal case studies. However, this alternative creates another problem: generalizations should be made with caution (Kimberly 1981).

3.5.2 Experiential Learning and the Problem-Solving Process

Although processes of organizational learning are commonly studied as a means of appreciating the developmental behaviour associated with many different aspects of organizational life (e.g. Ciborra and Andreu 1996; Senge *et. al.* 2000), there is also an innovation stream that considers and studies the innovation process as a learning process (Bessant 1993; Leonard-Barton 1995; Argyris 1992). By looking at IS implementation, Leonard-Barton (1995) argues that the managerial processes of user involvement and adaptation between the organization and the technology involve managing the creation and channelling of knowledge. Then, learning can be considered as one of the main issues around the innovation literature.

The theory of experiential learning based on works of Kolb (1984), Argyris and Schon (1978), Lewin (see Kolb 1984), and Dewey (1938) underlies key concepts to be applied in the ES implementation. As Kolb (1984) states, "learning is the process whereby knowledge is created through the transformation of experience" (p. 38). This definition encompasses two parts: knowledge creation and transformation of experience as a process. Two kinds of knowledge can be considered (Kim 1993): what people learn (know how); and how people understand and apply that learning (know why). The former refers to the acquisition of the ability to produce some action, which is also called operational learning. The latter refers to the acquisition of the ability to articulate a conceptual understanding of an experience, which is also called conceptual learning. An illustrative example was described by Kim (1993) for clarifying these two kinds of knowledge:

... a carpenter who has mastered the skills of woodworking without understanding the concept of building coherent structures like tables and houses can't utilize those skills effectively. Similarly, a carpenter who possesses vast knowledge about architecture and design but who has not complementary skills to produce designs can't put that know-why to effective use. Learning can thus be defining as increasing one's capacity to take effective action. (p. 38).

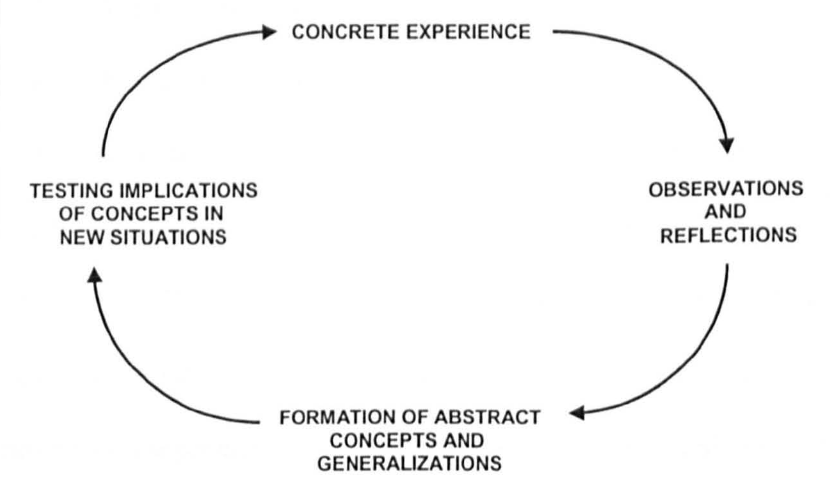
Knowledge-creation from experience takes the form of an ongoing cycle. There are many "wheels of learning" that describe this cycle (Senge *et. al.* 2000). This study takes that developed by Lewin as shown in Figure 3.4. As Kolb (1984) describes it, two issues are relevant here:

1. Experience as the focal point for learning, giving meaning to abstract concepts and at the same time allowing one to validate ideas created during the learning process;
2. The feedback process as a social learning and problem-solving process, which provides the cornerstone of goal-directed action and evaluation of the consequences of that action.

A problem-solving process view is also described by other authors (Argyris 1992; Leonard-Barton 1995). For Leonard-Barton (1995), shared and creative problem solving is one of the four key activities in the knowledge creation and in the diffusion process. Argyris (1992) points out that learning occurs under two conditions:

"When an organization achieves what it intended; that is, there is a match between its design for action and the actuality or outcome. Second, learning occurs when a mismatch between intentions and outcomes is identified and it is corrected; that is, a mismatch is turned into a match" (p. 8).

Figure 3.4 The Lewinian Experiential Learning Model



Source: Kolb (1984, p. 21)

Finally, it is important to note the emerging of a methodological debate. Easterby *et. al.* (2000) point out that an interesting debate has emerged around the need to identify the best way to investigate organizational learning. On the one hand, there is a need to develop valid and reliable measurement methods – i.e. the positivist stance. This stance takes the organization as the primary units of analysis. On the other hand, a number of scholars argue for studies, which collect qualitative data through participant observation and open interviews – i.e. the interpretative stance. The underlying motivation is to understand the organizational events and phenomena as they occur. The unit of analysis is the individual. However, reaching across these positions, there is a contingency view that different methods are appropriate for different research problems.

3.6 Summary

Chapter 3 establishes the background of the ES implementation research. By reviewing it in a comprehensive manner, the chapter identifies some research gaps and problems: there is not a consistent definition of ES implementation; the ES implementation research remains fragmented with most studies following the factors research stream; a large amount of case studies have been written, but with only a slight theoretical contribution; many works have focused on the project stage of the implementation process; and few works have considered the long-term requirements and challenges (e.g. diffusion, infusion, learning, and continuous improvements) around the ES implementation. Then, the chapter suggests the use of the innovation perspective for the study of the ES implementation. This perspective is suggested because it is concerned with the understanding of how an innovation spreads inside an organization and how extensively the innovation is used. That is, diffusion and use of the technology is part of the implementation issue. In addition, the innovation perspective integrates the learning, problem-solving, and continuous improvement processes into the implementation definition. Chapter 5 (the diffusion model) and chapter 6 (the infusion model) considers further IS and innovation literature and retake the models and theories presented above in this chapter, in order to build the diffusion and infusion models of ES from case study research.

CHAPTER 4: RESEARCH METHODOLOGY

This chapter aims to describe the research methodology conducted in order to answer the research questions of this investigation. The general methodology followed is that of theory generation from case study evidence. First, the chapter presents the philosophical position assumed by the researcher to explain the phenomenon under study. Then, the process of theory generation from case evidence is described in detail. The process takes methodological elements from distinct authors such as Glaser and Strauss (1967), Eisenhardt (1989), Yin (1994), and Miles and Huberman (1994). Four key sections group the activities and steps developed to generate the grounded theory. They are as follows: focusing and bounding, site selection, data collection and analysis, and enfolding literature. Finally, the chapter attempts to document the resulting iterative and cyclical qualitative model from this investigation, which can be considered as a process usable by others.

4.1 Philosophical Position

The aim here is to be explicit about the bias of the researcher. That is, to describe how the researcher explains the shape of the social world. It is advisable for researchers to make their preferences clear from the outset in this way (Miles and Huberman 1994). At the time of this research, I, the researcher, thought of myself as "realist". In particular, my version of realism is a type of critical realism, which has been developed by two contemporary philosophers of social science: Roy Bhaskar (1978; 1989) and Rom Harre (Harre and Madden 1975). Nowadays, critical realism has been also adopted by scholars in the organizational science (see e.g. Mingers 2000; Tsang and Kwan 1999; Dobson 2000).

Two main philosophical claims are stated by critical realism (Bhaskar 1978; Mingers 2000; Miles and Huberman 1994; Tsang and Kwan 1999; Woods 1999):

1. Social phenomena exist not only in the mind but also in the objective world (i.e. a realist view of *being* in the ontological domain), and
2. Knowledge is a representation of reality, but one that can only be known partially, not totally. Knowledge of causal laws governing the social reality is almost unattainable (i.e. the relativism of knowledge in the epistemological domain).

Since this research is based on replication and theory development (see section 4.3), it is important to know the implications of critical realism for these issues. While the role of replication in natural science is crucial for verifying or falsifying general laws, some social scientists consider that the principle of replicability should not be imposed on social sciences because their observations are unique in nature (Bleicher 1982; Dilthey 1976). To these social scientists, invariant laws are almost impossible in social science. However, other social scientists feel that replication is important to support or discredit theories in organizational science (Yin 1994; Miles and Huberman 1994; Tsang and Kwan 1999). The dilemma is then how one takes the principle of replicability whilst denying the positivist stance. Critical realism can reconcile these polar views by distinguishing the domains of the real and the empirical. "Since the empirical domain is not the deepest level of reality, the impossibility of invariable empirical laws does not imply the denial of objective reality" (Tsang and Kwan, 1999; p. 5). In addition, patterns of events do not mean invariable laws; they are the manifestation of the "real structures" under less than ideal conditions. Then, "the impossibility of constructing closed systems in the social sciences implies that the disciplines are primarily explanatory rather than predictive. The exclusive emphasis on prediction will even obscure the important role of explanation in natural science." (p. 6).

In the light of the above, one can argue that critical realism has qualities of both interpretativism and positivism. "In the actual practice of empirical research, all of us are closer to the centre (instead of the poles: positivism and interpretativism), with multiple overlaps." (Miles and Huberman 1994, p. 5).

4.2 The research approach: theory generation from case study evidence

The research methodology followed is that of theory generation from case study evidence. The aim is to generate a descriptive and explanatory theory of the ES diffusion and infusion inside organizations. This research approach consists of inducting theory using case studies. Several works of the process of theory generation from case study evidence have appeared in the literature (Glaser and Strauss 1967; Yin 1994; Miles and Huberman 1994; Eisenhardt 1989). Glaser and Strauss (1967) developed the comparative method for developing grounded theory. Yin (1994) has described the replication logic that supports the multiple-case analysis. Miles and Huberman (1994) described specific techniques analysing qualitative data in multiple-case designs. Finally, Eisenhardt (1989) outlined a road map for building theories from case study research. This research has taken different elements of design from these works to undertake this investigation (see section 4.4).

The theory generation from case study evidence approach is useful here, according to Eisenhardt (1989) and Orlikowski (1993), because it is appropriate:

1. To study processual issues, as well as the action of players, associated with a specific phenomenon over time,
2. To understand a phenomenon in its early stages of research - i.e. when little is known, and
3. To use a new perspective that allows achieving better understanding of a specific phenomenon.

4.3 The process of theory generation from case study evidence

A debate exists about how much shape a qualitative research design, such as theory generation from case study evidence, should have. Many social authors (e.g. anthropologists and phenomenologists) consider that social processes cannot be approached with explicit conceptual frameworks or standard instruments. They prefer loose structured approaches to gathering data. For them, the conceptual framework will emerge from the field in the course of the study and the important research questions will emerge only gradually (Miles and Huberman 1994). Some other authors are contrary to this extreme. Wolcott (1982) argues that "it is impossible to embark upon an investigation without some idea of what one is looking for." (p. 157). This stream suggests tighter designs: a preexistent conceptual framework, a set of research questions, and pre-designed instruments for collecting data. The stance taken in this research lies between these two positions: the definition of primary purposes, constructs and questions, but allowing an open-ended process of inductive approach and pattern recognition.

This position is similar to that of Pettigrew (1997), which is characterized in terms of cycles of deduction and induction. This is also consistent with the epistemological assumptions described above.

As mentioned before, the process of theory generation from case study followed elements from several authors. The process is presented below through four sections: focusing and bounding, site selection and data collection methods, data collection and analysis, and enfolding literature. They are developed in turn below.

4.3.1 Focusing and Bounding

At the time of the design of this investigation, the ES literature was not extensive and had focused on implementation project issues, rather than broader issues. Hence, the initial concern of this research was the understanding of the human, contextual and processual issues associated with the ES implementation and their impact on success. This was a broad initial definition of the problem. The investigation proceeded as it aimed to find more research focus through the development of a pilot case study. Some constructs and measures emerged from the pilot study, which causing a more specific focus for the research. This resulted in the formulation of specific research questions, the definition of theoretical cases, and the instrumentation of data collection devices. However, a definitive research focus emerged after the first site's data collection and early analysis. This is common in qualitative studies with an inductive approach (Eisenhardt 1989; Miles and Huberman 1994).

4.3.1.a The Pilot Case Study

The pilot case study is part of the exploration phase of this research. The main objective was to reach conceptual and practical clarifications that allow the researcher to identify a more focused theme beyond the general constructs previously defined: human, contextual and processual issues. Further specific objectives were to learn about the research process, the interview schedule, the overall length of the interviews, and observation techniques - as suggested by Glesne and Peshkin (1992).

The pilot study was carried out in the transportation sector, in the Underground Company (UC) of a South American city. The ease of access to this site by prior personal contact was the reason for the selection. Eight semi-structured and prolonged interviews were conducted in order to observe the ES phenomenon from different angles. An interview guide was designed and used by the researcher to lead the interviews according with the initial concern of this investigation. As can be seen in Table 4.1, four general questions were asked. People interviewed were: the Chief Executive Officer (CEO), the IT corporate manager, the ES project manager, the finance manager, three materials management key-users, one finance key-user. Each interview lasted an average of two and half hours. The researcher also participated as observer in two project meetings carried out by key-users and the project manager.

A brief description of the pilot case context is described in the following paragraphs. UC began with the implementation of an ES in 1996. At the time of the study, the ES implementation had gone through four key periods (see Appendix 2 for the full chronology of the implementation process):

1. A first attempt of implementation that ended in failure.

2. A second attempt of implementation in which the financial accounting functionality and the materials management functionality were implemented.

3. Business process re-modelling and system re-configuration to fit to the new business model designed by a new upper-management.

4. Planning the implementation of new functionality.

Table 4.1 Questions and Topics covered in the Pilot Case Study

Questions	Topics covered*
Has this project been successful? Why? How do you measure it?	• Project Measures (e.g. schedule, budget, functional scope) • Early Operational Metrics (e.g. labor costs, time required to fill an order). • Longer Term Business Results (e.g. ROI, use of the system, better decision making process because of higher quality data, improved customer service).
How do the human issues influence the ES success?	• Meanings • Interpretations • Attitudes.
What are the contextual issues that influence the ES success?	• Organizational Structure. • Power Relations. • Financial Resources. • Employee Skills. • Management Style. • Quality of Data. • Legacy Information Systems.
What are the processual issues that influence the ES success?	• Training • Configuration-Tailoring. • Knowledge Transfer • Organizational Adaptation • Implementation Objectives and Strategy. • Change Management.

*The topics covered in each question were taken from the ES and IS literature.

As a consequence of the pilot study results, concepts, constructs and the unit of analysis emerged to the research design. They are described in turn:

- The use of the system, after its implementation, emerged as the interviewees' main concern. From this, and considering the IS and ES literature, an ES-use construct was developed in order to address the ES implementation success. The resultant ES-use taxonomy encompassed the following constructs: transaction automation, decision-process making support, monitoring performance, customer service, coordination, and process management automation. They are explained in detail in chapter 6, which develops a conceptual framework of ES capabilities.

- In relation to contextual issues, outer context were considered as largely irrelevant by interviewees. The inner context variables that emerged as important were as follows: organizational structure, power relations amongst the functional areas, project budget and users skills.

- In relation to processual issues, the most important variables that emerged were as follows: end-user training, system configuration and tailoring, knowledge transfer from consultants to users, and organizational adaptation to the system models.

- In relation to human issues, meanings and attitudes developed by users were considered as influencing the use of the system.

- The pilot study also allowed the researcher to identify the appropriate unit of analysis to study the ES implementation and use. This is composed of the project team, key-users, and end-users.

Finally, the pilot study allowed the researcher to sharpen the research questions. The research questions designed to enter in the multiple-case research were as follows:

1. How extensively is an ES utilized in an organizational context?
2. How do the human issues influence the ES-use?
3. What are the contextual issues that influence the ES-use?
4. What are the processual issues that influence the ES-use?

By following these general questions, the interview protocol was re-designed for the data collection in the first case of the multiple-case study (see Appendix 3).

4.3.1.b Reaching A Definitive Focus After The First Case's Data Collection And Early Analysis

Once data collection and early analysis occurred in the first case of the study, the researcher discovered a further interesting phenomenon associated with the use of the system: The ES-use evolves in a virtuous continuous improvement cycle (Lorenzo 2001a). This encompasses 1) cycles of rollout and implementation of new functionality, 2) cycles of learning, and 3) cycles of improvement of business processes and system functionality already implemented. These early results were described in a previous conference paper presented by the author (Lorenzo 2001a). The writing and presentation activities allowed the researcher to achieve better understanding of the ES phenomenon, and motivated a further redesign of the investigation. The new focus lay in processual issues and ES-use. A review of the innovation literature allowed the researcher to find a link between the ES phenomenon and the innovation perspective. Then, the investigation was focused on the diffusion and infusion of ES inside organizations. The new research questions were re-defined as follows:

1. How do ES diffuse inside organizations?

2. How do ES infuse inside organizations?

The interview guide was redesigned again to follow these new research questions (see Appendix 4). The protocol encompasses topics related to the use of ES (ES capabilities), the activities and phases to diffuse an ES inside organizations, and the cycles of learning, improvement, and enhancement.

4.3.2 Site Selection and Data Sources

The selection process considered Glaser and Strauss' (1967) technique of theoretical sampling. The goal of theoretical sampling is to choose cases that are likely to replicate or extend the emergent theory (Yin 1994; Eisenhardt 1989). This research took Yin's (1994) suggestion of following literal replications. That is, the logic was to select cases so that they predict similar results. A major benefit of this strategy is to develop a rich theoretical framework of a particular phenomenon under specific conditions. The main issue was to choose organizations that had acquired an ES, had installed it in at least one business unit, and had decided (or had begun) the deployment of the system to further business units and processes. That is, the system had already been available to use and was simultaneously being implemented on further areas.

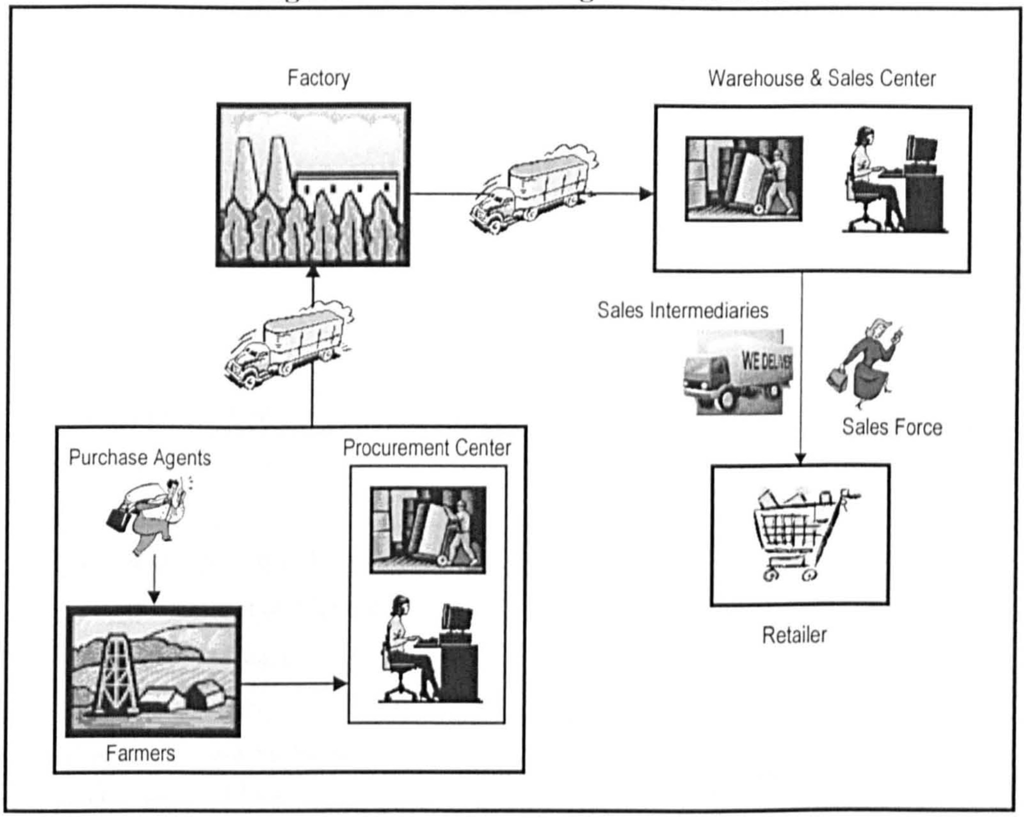
In addition, another research purpose was to generate theory applicable to different contexts. Then, differences between the sites were also sought. First, the research was realized in organizations adopting ES from distinct providers (e.g. SAP and Baan). Second, companies selected come from three distinct types of industries. The companies are called in this work as CC (the coffee company), ESC (the engineering services company), and CPC (the chemical products company). The names of the three sites have been disguised.

4.3.2.a CC – The Coffee Company

Founded in 1958, CC is a nationally leading company in the processing and distribution of roasted and ground coffee in one of the South American countries. Since 1992 CC has been exporting green coffee to the USA and Europe. In 2001, it earned US$45 million in revenues and employed 370 persons. Figure 4.1 describes CC's business model in outline. The factory is the company's modern processing plant where coffee is roasted, ground and packaged. CC has a number of procurement centres located in the most important coffee regions over the country. Here, farmers sell their products directly to CC and independent purchase agents purchase coffee for CC. In the domestic market, CC distributes its products with its own trucks to 12 regional warehouses throughout the country. The company sells its products to 43 independent intermediaries, which then reach more than 11.900 final retail destinations. CC has also a sales force of 35 persons, which is responsible for selling to more than 700 big retail destinations (e.g. big supermarkets and chains).

CC acquired an ES in 1997 by purchasing it from one of the top five vendors. This ES was installed between 1997 and 1999 (the first version of the system was available for use in 1999). Then, between 1999 and 2002, the organization was engaged in a diffusion and infusion process to support more organizational functions and business units.

Figure 4.1 The CC's Logistic Processes



The researcher captured the process through a combination of retrospective and real time analysis. Frequent visits were carried out over a period of eighteen months. The primary methods of data collection were semi-structured interviews, observation and documentary review. Forty-one semi-structured interviews were conducted, each lasting an average of one and half hours. The interviews included people related to ES implementation in one way or another: upper-management, functional management (key users), end users, technical specialists, project team, members of the personal department, and consultants. Table 4.2 shows the role breakdown of the different interviewees.

The researcher also carried out participant observation in six monthly review meetings – each dedicated to managing and evaluating the ES implementation and lasting an average of three hours. Some training sessions were also attended. A review of documents focused on memos, users manual, procedures, system manuals, and reports of earlier implementation phases.

Table 4.2 Position and Number of Interviews Conducted at CC

Interviewee Position	**Amount**
Upper-Management	
President (CEO)	2
Vice-president of Administration and Finance (CFO)	1
Functional Management (Key Users)	
Administration Manager	2
Treasurer	1
Information Systems Manager	4
Sales Administration Manager	3
Procurement Manager	1
Logistics Manager	1
Production Planning Manager	1
End-Users	
Production Supervisors	2
Packaging Supervisor	1
MRO Central Warehouse Supervisor	1
Delivery Supervisor	1
Distribution and Transport Supervisor	1
Regional Warehouse Administrative Assistants	3
Administration and Accounting Supervisor	1
Accounts Receivable Assistant	1
Accounts Payable Assistant	1
Purchaser	1
Quality Assurance Supervisor	1
Internal Support	
Information Systems Technical Assistant	1
Rollout Project Team Members	4
Members of Personnel Department	
Human Resources Supervisors	2
Consultants	
ES outsourcing consultants	4
Total	**41**

4.3.2.b ESC – The Engineering Services Company

ESC is a corporation based on a group of companies acting as cost-benefit centres responsible for their own results. They can be categorized into three main business units: Engineering, Procurement and Construction (EPC), Petroleum Operations (PO), and Telecommunications Operations (TO). EPC's activity is directed to the engineering, procurement, and construction of big petroleum and energy facilities such as refineries and electrical plants. PO is concerned with the crude oil exploration and drilling. This business unit is a joint venture with multinational petroleum companies. TO is a service company that installs and maintains telecom facilities.

These three business units operate independently within ESC but, despite this, the ES implementation was managed by a centralized team. The corporate Chief Finance Officer (CFO) was assigned as the project leader. The way that ESC defined its implementation objectives and planned and performed its ES project suggests that it should be considered here as a single case. ESC acquired an ES in 1997. At the time when the researcher entered the company, they had already implemented the financial accounting functionality and the human resources functionality. They also were planning and implementing functionality in further business units such as engineering and materials management. That is, they were using the system in some areas whilst implementing it in others.

In ESC twenty-three semi-structured interviews were conducted (see Table 4.3), each lasting an average of one and half hours. Documentary review focused on memos, users manual, procedures, system manuals, and reports of early implementation phases. The researcher also participated as observer in three project meetings.

Table 4.3 Position and Number of Interviews Conducted at ESC

Interviewee Position	Amount
Upper-Management	
President (CEO)	1
Finance Vicepresident (CFO) – ES Leader	2
Business Unit Manager	1
Functional Management (Key-Users)	
Information Systems Manager	2
Human Resources Manager	1
ES Department Manager	2
Engineering Project Manager	1
Controlling Manager	2
End-Users	
Human Resources User	1
Financial Accounting Users	3
Warehouse Assistant	1
EPC Project Engineers	3
Internal Support & Consultants	
ES Project Manager	2
Consultants	1
Total	**23**

4.3.2.c CPC – The Chemical Products Company

CPC is in the chemical distribution business. The company operates distribution and sales service centres in six cities of a South American country. Bulk liquids storages are maintained at the country's main ports for receipt of import parcels. CPC sells a broad range of high value additives and chemicals to target markets that include surface coatings, food, personal care, pharmaceuticals, oil and gas, plastics and other industrial sectors. Two presentations for the products are available: bulk liquids and liquids in drums.

CPC carries out four key processes: procurement logistics, external accounting, distribution, and sales logistics (see Figure 4.2). They are described below:

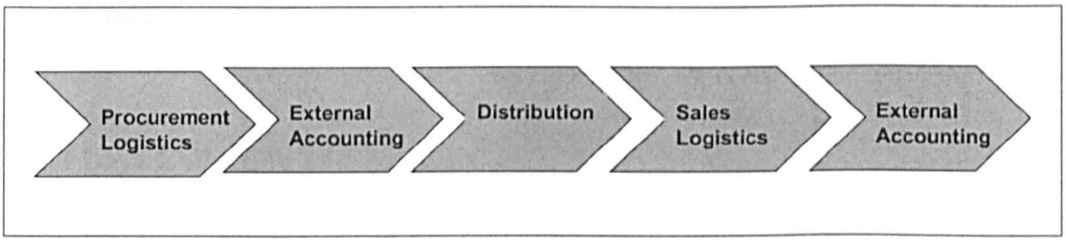
- Procurement Logistics is concerned with buying and obtaining products worldwide. This process involves several activities such as determining the needs, locating supply sources, evaluating and selecting one or more suppliers, choosing buying methods, monitoring the purchase's status, receipting, evaluating and storing the products.

- External Accounting involves key areas such as accounts payable and accounts receivable, which are closely linked to cash management and forecasting. As in any other distribution company, this is the vital business process in CPC.

- Distribution refers to replenish products (only those liquids in drums) into remote distribution warehouses from central warehouse.

- Sales Logistics involves three key sub-processes: sales activity processing, customer request for quotation (RFQ) processing, customer sales orders (CSO) processing, and delivery processing.

Figure 4.2 CPC's Value Chain



In CPC seventeen semi-structured interviews were conducted, each lasting an average of one and half hours (see Table 4.4). The researcher also participated as an observer in fifteen work sessions (each lasting an average of two and half hours) between managers, users and consultants. These work sessions were related to: 1) the definition of business strategy; 2) the IT planning; 3) the definition and design of business models and; 4) the definition of the system's tailoring options.

Documentary review was focused on strategic planning, memos, procedures, and reports of early implementation phases.

Table 4.4 Position and Number of Interviews Conducted at CPC.

Interviewee Position	Amount
Upper-Management	
General Manager (CEO)	3
Functional Management (Key-Users)	
Administration Manager	2
Information Systems Manager	2
Sales Manager	1
Operations Manager	2
End-Users	
Procurement Supervisor	1
Receivable Account Assistant	1
Payable Account Assistant	1
Treasurer	2
Internal Support & Consultants	
Information Systems Technical Assistant	1
ES outsourcing consultants (2)	1
Total	**17**

4.3.3 Data Collection and Analysis

Since the aim of this research has been to generate theory from case research, the replication approach was considered as a major issue in the research design. Behind the replication logic there are several purposes. First, replication enhances confidence in the validity of the relationships (i.e. internal validity) and enhances the reliability of the measurement instruments used in the study (Yin 1994; Eisenhardt 1989; Tsang and Kwan 1999). The logic used in this research was to select cases so that each case predicts similar results - i.e. literal replication as suggested by Yin (1994).

From the result of a single in-depth case study, the researcher developed an initial diffusion and infusion theory of ES inside organizations. The first case under analysis was that of the coffee company (CC). At this site, data collection and analysis proceeded iteratively. The analysis was more open-ended and generative than at the two other sites (i.e. ESC and CPC). The focus was the development of concepts, constructs, and relations to generate a grounded theory. The initial concepts that emerged at this first site were then compared and contrasted with the other two ES experiences. Hence, data collection and analysis in the other two cases were more targeted, involving a more structured interview protocol (see Appendix 4). The questions in the new interview protocol were designed to investigate the emerging concepts and constructs (those generated by the CC data) in the others two sites. Then, data from the second and third sites were sorted according to these initial concepts.

However, it soon became clear that some findings emerging from the second and third sites did not match with the initial constructs generated by the CC data. Matching the ESC and CPC data with the initial concepts also led to some clarification and reconsideration of the early theoretical framework. For example, the results from the first site suggested that the customer service and coordination capabilities in the infusion model were developed independently at the same time. In fact, customer service was initially placed first, before coordination (see Tables 6.1, 6.2, and 6.3). However, after the second and third sites were analysed, the researcher discovered that the coordination capability was developed before the customer service capability. Moreover, it became evident that coordination was needed to develop the customer service capability. Redefining the initial findings to incorporate considerations of the ESC and CPC's experiences required returning to the CC data and re-analysing them to take into account the new findings. The result was that CC had the same behaviour as ESC and CPC. Both coordination and customer service were developed at CC in the same year, but checking the CC data confirmed that coordination was developed first, before customer service.

The iteration between data and concepts ended when enough constructs and concepts had been defined to explain what had been observed at all sites, a situation that Glaser and Strauss (1967) refer to as "theoretical saturation." Theoretical saturation is simply the point at which incremental learning is minimal because the researcher is observing phenomena seen before (Glaser and Strauss 1967; Eisenhardt 1989).

As mentioned above, data from three sites were collected through a variety of techniques: un-structured interviews, semi-structured interviews, documentary review, and observation. This triangulation of data collection is advisable in theory generation because it gives multiple perspectives on an issue and allows for cross-checking (Eisenhardt 1989; Glaser and Strauss 1967). The analysis of data in each case followed the Miles and Huberman's (1994) techniques. The analysis consisted of three concurrent flows of activity: data reduction, data display, and conclusion drawing/verification.

Data reduction refers to the process of transforming data from the written-up field notes to a more focused and organized way that eases the conclusion drawing and verification. Some of the data reduction techniques used in this research was as follows:

- *Contact summary sheet* is a single sheet that summarizes main points of a particular contact.

- *Codes* are labels that are attached to words, phrases, and sentences connected to a specific setting. Codes are used to retrieve and organize data.

- *Reflective remarks* refer to enter reflections (e.g. doubts, second thoughts, and feelings) directly into the write-up.

- *Memos* are conceptual elaborations that link together pieces of data into a recognizable cluster or general concepts. Memos are considered powerful sense-making tools at hand. "In the inductive approach, memos often serve a clustering function; they pull together incidents that appear to have commonalities." (Miles and Huberman 1994; p. 74).

- *Interim case summary* is a provisional report that provides a review of each case's findings.

Data display is a second step in the process of transforming the data towards the generation of theory. A display is "an organized, compressed assembly of information." (Miles and Huberman 1994, p. 11). The main displays used in this research are matrices and graphs. These displays allowed the researcher to assemble and organized data into a compact form so that the analysis was eased. For instance, the ES diffusion process was displayed in the matrix labelled as "Events by Chronological Time Periods and the Diffusion's Activities-Loops." (see Tables 5.1, 5.2, 5.3). Rows represent the ES diffusion's activities and loops (i.e. the main constructs that emerged from the case evidence) and columns represent periods of time, which reflect the processual nature of the phenomenon. Then, for each case under study the researcher entered the data in the cells following a systematic and analytical work. Matrices allowed the researcher to compare events amongst the three sites.

The third step of analysis is conclusion drawing and verification. From the outset of the analysis activity, the researcher was noting regularities, patterns, and explanations. Although conclusions were initially vague, they became explicit and grounded by iterating data collection, data reduction and data analysis over time. It is important to note that the generation of conclusions is the least codified part of the analysis process (Eisenhardt 1989; Miles and Huberman 1994). At the outset, the researcher gave special importance to plausible conclusions. Later, some of Miles & Huberman's (1994) suggestions were followed such as noting relations between constructs and building a logical chain of evidence. Once conclusions emerged, precautions were taken to corroborate the interpretations made (i.e. conclusions verification). Verification encompassed checking field notes during the writing process, getting feedback from informants (i.e. people that were interviewed) and getting feedback from third parties (e.g. an ES consultant, two scholars, and people that participated in three research seminars).

Finally, ATLAS/ti assisted the researcher to analyse the data collected from the field. This is one of the computer software packages for qualitative data analysis recommended by Miles & Huberman (1994). ATLAS/ti aided the researcher in dividing text into segments or chunks, attaching codes to chunks, and finding and displaying segments by code. The software also aided the researcher in marking and writing extended memos about the meaning of data and codes.

4.3.4 Enfolding Literature

Linking results to the literature is crucial in theory generation from case evidence when findings rest on a small number of cases. By enfolding literature the internal validity and generalizability are enhanced (Eisenhardt 1989). The ES literature allowed the researcher to compare and validate the emerging constructs with the extant works. In fact, before showing evidence from the sites under study, the emerging constructs related to the ES diffusion and infusion are presented according with definitions and evidence from the ES literature (see section 5.1 and section 6.1 respectively). On the other hand, the grounded theory was connected to existing formal theory in order to generate a more general substantive theory. For instance, the ES diffusion model was connected to Tyre and Orlikowski's (1994) technological adaptation model. As a result, the ES diffusion features were classified according with continuous and discontinuous patterns of improvement (see section 5.5.3).

4.4 Strengths and weaknesses of the theory generation from case study evidence

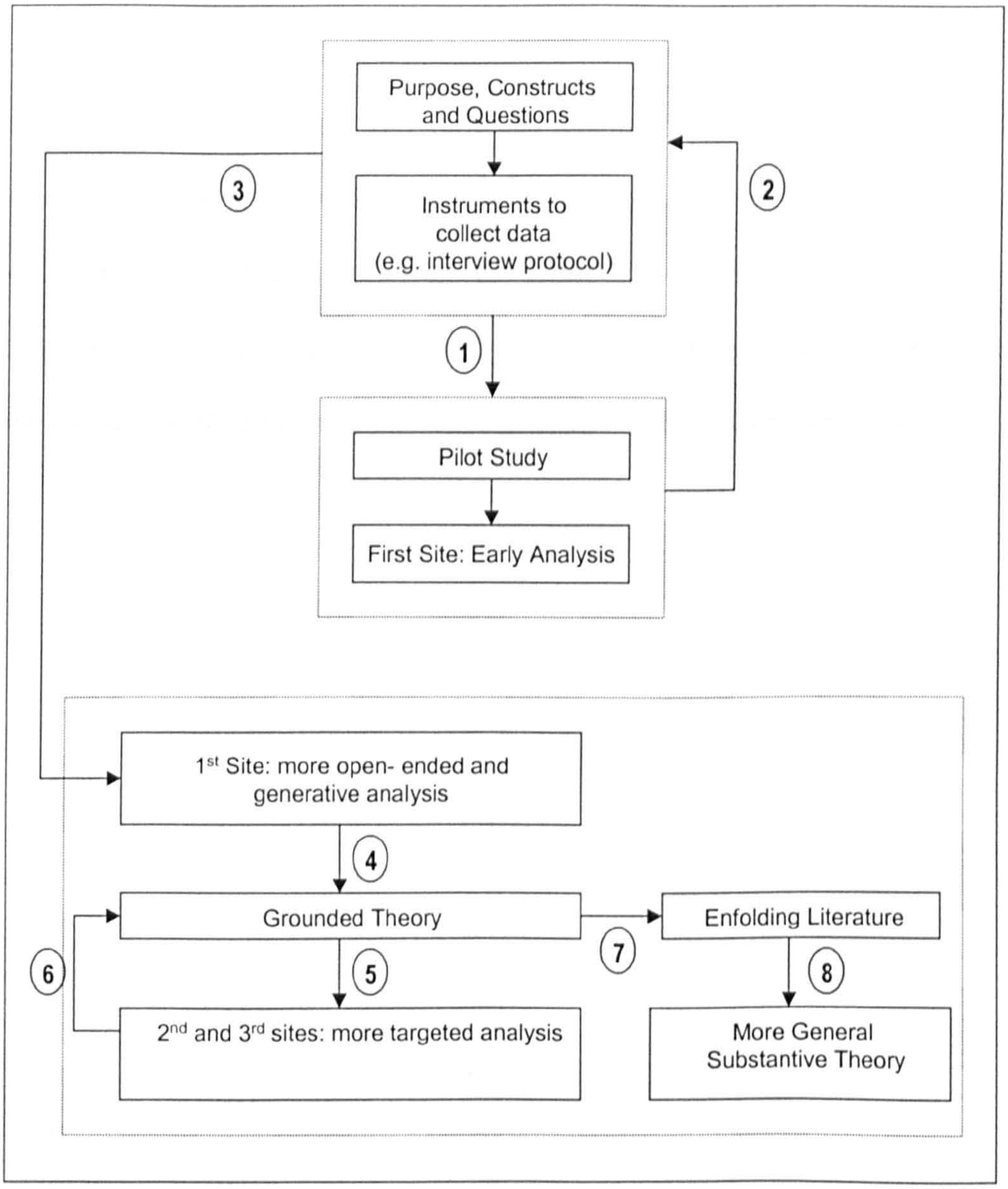
The major strength of the theory generation from case study evidence is its possibility of generating novel theory (Eisenhardt 1989). The resultant theory is empirically valid because it is intimately tied with evidence. The methodology is focused on "ordinary events in natural settings." (Miles and Huberman 1994). The data collection and analysis techniques allow a close proximity to the phenomenon under study. This aided the researcher to understand underlying and non-obvious issues embedded in the ES diffusion process such as the learning and improvement cycles (see chapter 5). This approach is also useful to study processual issues and the action of key players. This was the case in this investigation in which the resultant ES diffusion and infusion models describe the activities and events occurring over time as well as the central role played by key-users, end-users, and consultants. The approach allowed the researcher to go beyond asking "what" is happening to ask "how" things happen.

Theory generation from case evidence also has some weaknesses. A number of authors believe that generating theory from a limited number of cases is susceptible to the researcher's preconceptions (Miles and Huberman 1994; Eisenhardt 1989). However, this risk can be lowered. Eisenhardt (1989) points out that the iterative comparison across sites, methods, evidence and literature that characterizes this approach leads to "unfreeze" thinking so that the researcher bias is reduced, or eliminated. It is argued that this occurred in this research. A second debate is about the complexity of the resultant theory. Some argues that the intensive use of empirical evidence can yield a complex theory, instead of a parsimonious one. This was indeed a challenge in this research because of the characteristics of the phenomenon under study. Several decisions helped the researcher to avoid this pitfall. First, the research focused on processual issues, contrary to the initial idea of investigating human, contextual, and processual issues in a single research exercise. Then, the replication logic aimed to confirm the emerging theory, but the researcher resisted the temptation to add related phenomena into the diffusion model. (e.g. the system upgrade). The researcher chose to leave these related phenomena to be studied in further works. It is impossible to capture everything in just a single theory.

4.5 Summary

The activities grouped above in four key sections (focusing and bounding, site selection, data collection and analysis, and enfolding literature) can be documented as an iterative and cyclical model, which is usable by others. Figure 4.3 depicts this iterative model of generating theory from case study evidence.

Figure 4.3 The Iterative and Cyclical Process used in the Generation of Theory



Once the researcher defines primary purposes, constructs and questions, initial instruments to collect data are designed to enter the pilot case study. The pilot study allows the researcher to achieve a more focused theme. Hence, data collection instruments are re-designed and the researcher enters into the first case. Although the first site is part of the multiple-case study, this also plays an important role in the aim of achieving a more focused theme. For instance, in this research, the definitive focus was achieved after the early analysis of the first case's data. A loop occurs from the pilot study and the first case results to define the new purposes, constructs, and questions in the investigation. By doing an open-ended and generative analysis, a grounded theory emerges from the first case. The resultant theory is contrasted and validated against further cases. Data collection instruments are re-designed again in order to carry out more targeted analysis on the further cases. A loop occurs from the further cases results to adjust the theory according with the new findings. Finally, the grounded theory is converted into a more general substantive theory by linking results to the existing literature.

CHAPTER 5: A MODEL OF INTERNAL DIFFUSION OF ENTERPRISE SYSTEMS

This chapter aims to answer the first research question of this investigation: how do ES diffuse inside organizations? (see chapter 1). For this, a model of ES diffusion inside organizations has been developed from the three organizations' experience. The model has also considered ES literature (e.g. Bancroft 1998; Prince 1998) and the prescribed implementation processes of ES vendors and consultants (e.g. Miller 1998; Jendry 2000). Hence, a more general substantive theory results as a consequence of connecting the grounded theory to existing literature (Glaser & Strauss 1967; Eisenhardt 1989). This enhances the internal validity, generalizability, and theoretical level of any theory building from case study research (Eisenhardt 1989). The model itself was developed as part of the investigation of the first of the three documented case studies. It was re-applied, developed, and validated in the two subsequent case studies (see chapter 4: research methodology). It is presented on this basis as an initial formulation. Further internal diffusion works around ES should add to or modify the ideas presented.

The model is given in Figure 5.1. The figure depicts the concepts and interactions that emerged as significant from data analysis. To explain this, five related sections are presented below. First, the concepts and the logic of the model are explained. The second, third, and fourth sections present the evidence from the three sites that support all of the concepts in the model. Finally, a discussion of the model is developed. The latter encompasses: a) the recognition of ES diffusion's distinctive features, b) the identification of the learning challenges required by ES diffusion, and c) the classification of each site according to the timing of the diffusion process.

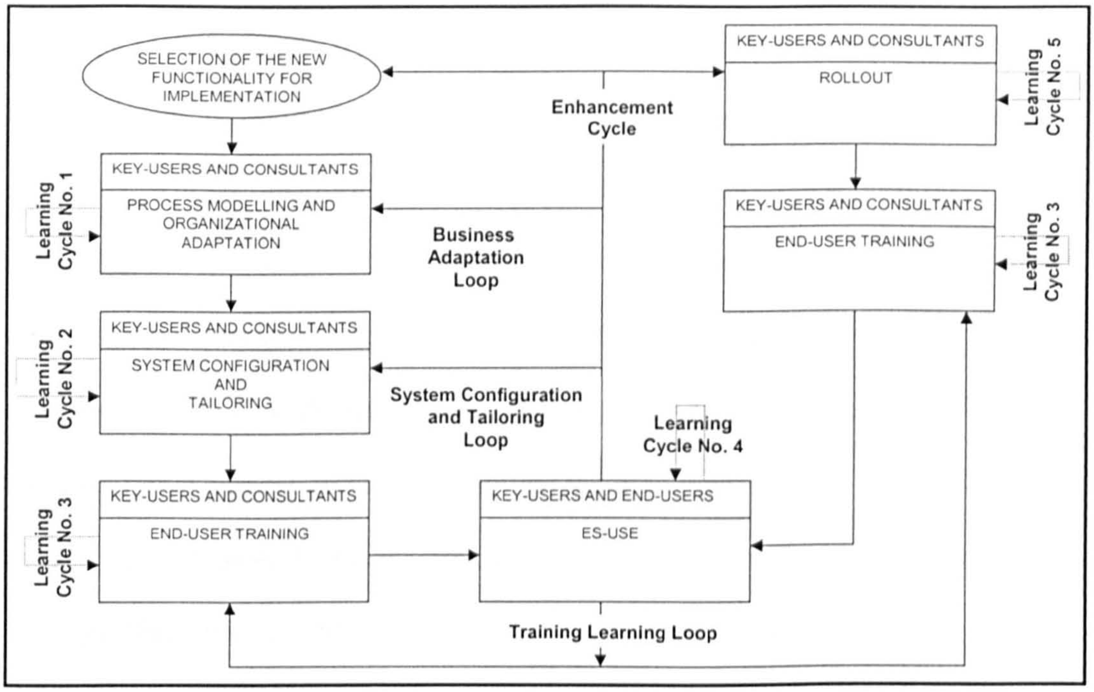
5.1 Definition of Concepts and the Logic of the Model

First, symbols and language have been designed to aid the reader to understand the model. Four key symbols (shapes and lines) can be identified in Figure 5.1:

1. The elliptical shape represents the trigger of the process. This is given by the definition of a set of functions that is to be implemented.
2. The quadrilateral shapes (boxes) represent the activities to be carried out in the diffusion process. They also encompass: a) roles in charge of each activity (e.g. key users, end users, and/or consultants) and b) learning cycles associated with each activity (these cycles are drawn as loops next to each box).
3. The lines without labels (i.e. without a particular name that identifies them) represent the sequence of the activities, which ends in the use of the system (e.g. box labelled as End-User Training). Two blocks of activities can be identified: the left hand side and the right hand side. Each block finalizes in the central box called ES-use located at the bottom of the diagram.
4. The labelled lines represent the four feedback loops from the ES-use box (e.g. enhancement cycle, business adaptation loop, system configuration and tailoring, training learning loop).

In order to help the reader in tracking the explanation of the model, the following tactic has been deployed in the subsequent paragraphs: the activities of the diffusion process (e.g. process modelling and organizational adaptation) are named with underlines and the learning cycles and loops (e.g. business adaptation loop) are named in **boldface**.

Figure 5.1 The Model of Internal Diffusion of ES



Starting on the left side of Figure 5.1, the trigger of the whole diffusion process is to define a set of functions that is to be implemented. This choice is itself a function of organizational goals and the state of the organization's learning about ES. The chosen functions are then activated over time in specific processes or units.

The model describes the further progress of ES implementation as relying on experiential use and the learning associated with each activity in the overall process. It contrasts sharply with an absolute big bang implementation approach as new requirements or needs emerge over time. It also describes the dynamic complexity of a large-scale ES implementation, as the organization learns about adoption of functionality, adaptation of its business processes, the configuration of the system and the further tailoring of its functionality. In more detail, its components are set out below.

The first logical activity is process modelling and organizational adaptation. This is carried out by key users and consultants. These two roles face the important responsibility of leading decisions about how the organization's processes will be mapped and adapted (Volkoff and Sawyer 2001). Process modelling is used as an instrument to decrease the gap between the ES and the organizational needs (Rosemann *et. al.* 2001). Key users bring the business knowledge and consultants have the product knowledge (Soh *et. al.* 2000). Organizational adaptation occurs to follow the modelled process. For instance, this could imply changes in roles, procedures, sequence of tasks, and organizational structure (Brehm *et. al.* 2000; Davenport 1998; Lorenzo 1998b).

Associated to this activity is **learning cycle No. 1**. The first knowledge acquired by key users is the action (know-how) of modelling business processes. Rosemann and his colleagues (2001) consider that the modelers need to know about modelling methodology, modelling language, and a modelling tool. More broadly, to do modelling effectively, it is necessary to have a clear understanding of organizational needs, ES business practices and ES integration philosophy.

Once process modelling and organizational adaptation occur, system configuration and tailoring take place. As mentioned previously, configuration refers to the setting of parameters in the package to support organizational procedures and processes. Tailoring the ES refers to adaptations that go beyond this[6]. It encompasses activities such as additional programming and implementing

[6] Brehm and his colleagues (2000) include configuration as part of the typology of ERP tailoring types. However, this work separates configuration from the typology of tailoring in order to distinguish the technical

add-ons, modifications and interfaces with other ES and legacy systems (Brehm *et. al.* 2000; Markus *et. al.* 2000). The knowledge required to configure and tailor the system is acquired through **learning cycle No. 2.**

The last activity before using the system in the day-to-day operations is developing end-user training. Key-users are given responsibility for carrying out this activity (Bancroft 1998). They are trained in turn by ES consultants. This activity of training the trainers is considered to be a major part in the knowledge transfer process from the consultants to the organization. Key-users are required to develop end-user training materials and sections of the final procedure manuals. The knowledge creation in this activity occurs through **learning cycle No. 3**.

All of the activities described above act as preparation for the system to go live and be used. ES-use is the major goal of the ES implementation. However, the dynamic relations between the activities are not linear, and are more complex than a simple precedence connection. Although some authors place the system usage after implementation (Bancroft 1998), ES-use here is better understood *as part of the ES implementation*. This is because ES-use is the trigger of the main experiential learning processes that further encourages the diffusion process (see the **four feedback loops** in Figure 5.1).

The use of the system allows organizations to develop both operational learning and conceptual understanding. Operational learning is associated with the use of the system to, for example, register and retrieve data. In some ES, this can be complex. This complexity might necessitate different learning strategies by the users. The **learning cycle No. 4** acts here clearly as experiential learning. When

activities associated with adapting the organizational processes to the system from those related to tailor the system to organizational requirements.

users have recurrent doubts or questions, companies schedule new training for specific sets of users. Hence, the **training learning loop** is activated.

The process of using the ES also allows organizations to increase conceptual understanding about the integration concept underpinning ES and the organizational needs associated with it. Following Argyris' concepts (1992), learning can be said to occur when the implemented processes can be considered as representing a definitive version. That is, there is a match between the modelled processes and the actual processes. On the other hand, where there is a mismatch between the modelled and actual processes, the organizational learning activities will seek to move towards a final version. This kind of mismatch can have many causes. It might, for example, relate to organizational needs not considered previously in the analysis activity; or this mismatch might "appear" as key-users understand the true ramifications of the ES integration concept after they have gained some use of the system.

The presence of any kind of mismatch between the actual and modelled processes activates the **business adaptation loop** and/or the **system configuration and tailoring loop**. Once key-users reflect on the mismatch and understand the reason for it, they recommit to either or both of the <u>process modelling and organizational adaptation</u> activity and the <u>system configuration and tailoring</u> activity. In other words, they seek to adapt the organizational processes or the system functionality. The idea of such an adaptation process is not new in the innovation and information systems literature. The concept has been already studied in other works (e.g. Tyre and Orlikowski 1994; Leonard-Barton 1988). For instance, Tyre and Orlikowski (1994) use the term "technological adaptation" to refer the adjustments and changes following installation of a new technology. In addition, Leonard-Barton (1988) points out that the adaptation process "is precipitated by implementation misalignments – mismatches between the technology and the organization recognized at the time of initial or trial use" (p. 255). She calls it as "mutual adaptation".

The fourth feedback-learning loop from the ES-use box is the **enhancement cycle**. This occurs when the company decides to:

1. Implement new ES functionality on additional business functions or processes which implies iteration of the cycle of process modelling and organizational adaptation, system configuration and tailoring, end-user training, and ES-use;
2. Spread out a particular ES functionality already implemented into new business units or dependencies, which implies running the rollout box. Rollout is the ongoing and further release of designated functionality into the business units (Markus and Tanis 2000; Couillard *et. al.* 1999). It is the process through which the organization achieves further diffusion of the functionality that is already in use. The knowledge to be acquired here by key users is the action (know-how) of doing rollout from a methodological perspective (e.g. iterative configuration of similar warehouses). This occurs under **learning cycle No. 5**.

Such enhancements might be pre-planned or might arise out of organizational learning as the system is in use. For instance, when the companies under study felt themselves to have satisfied its original needs and objectives, new objectives and ideas emerged. Thus the ES diffusion follows an iterative and virtuous process.

In the following sections, these concepts and their interaction over time are discussed in detail for each of the three field studies. This discussion describes their derivation and validation. The case studies are presented in chronological order.

5.2 Coffee Company (CC)

CC is in the business of processing and distributing roasted and ground coffee. CC owns a modern processing plant where these processes take place and packaged products are produced. The company buys green coffee through its procurement centres located in coffee regions. In the domestic market, CC distributes its products to twelve regional warehouses throughout the country. Then, the company sells its products to independent intermediaries, which reach final retail destinations. CC also possesses a small sales force that sells to big retail destinations such as chains (see Figure 4.1).

The implementation of the ES in CC is described here matching the evidence found in the field with the activities and loops that represent the model of internal diffusion of ES (Figure 5.1). Then, in turn, the CC's evidence that constitutes the model's concepts is discussed.

5.2.1 Selection of the new functionality for implementation

CC's ES project began with the implementation of the financial accounting functionality as a central repository of all transactions (e.g. accounts payable, accounts receivable, and general ledger). As about the same time, as part of the process of implementation, they also implemented functions associated with outbound and inbound logistics (i.e. materials management, distribution and sales). Later, the manufacturing functionality and the service operations functionality were also implemented. In 2002, CC planned to implement a set of new functionality such as transport operations, B2B, executive information system, and assets management.

5.2.2 Process Modelling and Organizational Adaptation

Once the functionality had been chosen for implementation, CC set in motion the process modelling and organizational adaptation activity. While some processes were effectively modelled in an initial attempt, other models were reviewed later in order to adapt to new needs or learning. Comprehending this disconnection between the initial modelling activities and those that followed use of the ES, led to the identification of the **business adaptation loop**.

One example of the effective modelling of processes related to the distribution and sales process. In CC a clear understanding of the distribution and sales model was developed within **learning cycle No. 1**. CC took more than a year in designing this new distribution and sales business model. This process considered both organizational needs and ES business practices. Examples of these different considerations follow. Organizational needs that emerged were to: 1) automate credit policies to control sales to intermediaries in order to encourage the company growth in a secure way, 2) control the intermediaries' sales to final clients, and 3) keep the current company's sales bonus scheme. At the same time, CC learnt about ES practices (e.g. Distribution Requirements Planning) previously unknown to them. These ES practices influenced the final version of the business model. As a manager commented, "the system allowed us to know and understand new business practices, which guided us to change the way of operating our business".

Organizational adaptation occurs concurrently with, and by mutual reference to, the modelling activities. An example relates again to the distribution and sales process. This process was the focus of a series of mutual adaptations that were carried out across the distribution and sales process and the system (see also **System Configuration and Tailoring** below). On the organizational side, CC eliminated a number of activities not supported by the ES and changed organizational roles. One effect was that sales assistants in regional sales centres can now finalize[7] accounts receivable transactions in the system, allowing them to process a new sale immediately. This necessitated role changes for these sales assistants. As a CC manager stated, "it was necessary to enlarge functional skills related to sales administration of the sales centres' managers and assistants; ...in some cases we got to recruit new personnel".

5.2.3 System Configuration and Tailoring

Some of CC's key users acquired the skills and knowledge necessary to configure the system. However, they relied on ES technical specialists for tailoring. Generally, consultants acted as ES specialists. However, the CC's IT department also learnt about the product's language which allowed them to realize some system adaptations. In fact, the IT department was able to minimize the use of

[7] Transactions entered will be classified as non-finalized until they are processed to the general ledger. Up to that point, changes can be made to the transactions. Once postings to the general ledger are finalized, no more changes are allowed. Although this is a mandatory step, it may not necessarily be done as part of the accounts receivable procedure. In the system, this session actually belongs to the General Ledger module and could be run instead as part of the general procedure to finalize transactions from all finance modules (see Baan Education Manual).

consultants year by year. This acquisition of knowledge would allow them configure and tailor the system over time. Such acquisition revealed the action of **learning cycle No. 2.**

A number of examples of configuration and tailoring are available in the CC study. For example, in order to support the distribution and sales process, the system was configured to support company credit policies to control sales intermediaries. The system was tailored in several additional ways as well. Examples of tailoring were 1) an interface between the ES and a human resource application from a third-party provider; 2) the creation of fifty new data outputs and reporting options for areas such as distribution and sales, finance, and purchase; 3) programming in the provider's language to adapt the system for calculating the distribution requirements to remote warehouses according with the company's practices.

An interesting example of tailoring the ES was that of programming in the provider's language to add functionality in the system in order to record the intermediaries' clients (i.e. retailers) and their purchases. This was done in a way that meant that they were not considered by the system as CC's clients. For CC it is very important to record this information in order to track the company's total market. Although the intermediaries' clients are not the company's direct clients, they are the final clients in the supply chain before consumers. A complementary technology was also utilized in reaching this objective: the hand-held computers (HHCs). CC gave HHCs to its intermediaries to record all transactions with these final clients. Alongside this, an interface between the ES and the HHC's application was developed.

5.2.4 End-user Training

Once the selected system's functionality was configured and tailored, the ES was ready to be used, save for the need to train end-users. End-user training in CC followed an important adult learning principle (Couillard *et. al.* 1999): end-users should apply new skills on the job immediately after training.

Although it was planned that key-users were given responsibility for carrying out end-user training, the reality in CC was that high personnel turnover affected the way the company tackled this activity. This meant that consultants often occupied the trainer role instead of key-users. Gradually the problem diminished as CC addressed the issue of high personnel turnover. As it did so, new key-users were engaged as trainers. As enquiry into these issues was developed, the nature of **learning cycle No. 3** became clear. CC's key users had no prior training or coaching experience. One of them pointed out that she was learning this particular skill over time. She considered that one of the most important lessons for her was that "each person learns at a different speed, ... and some learn more by doing rather than listening." Thus, the users had to learn about training itself.

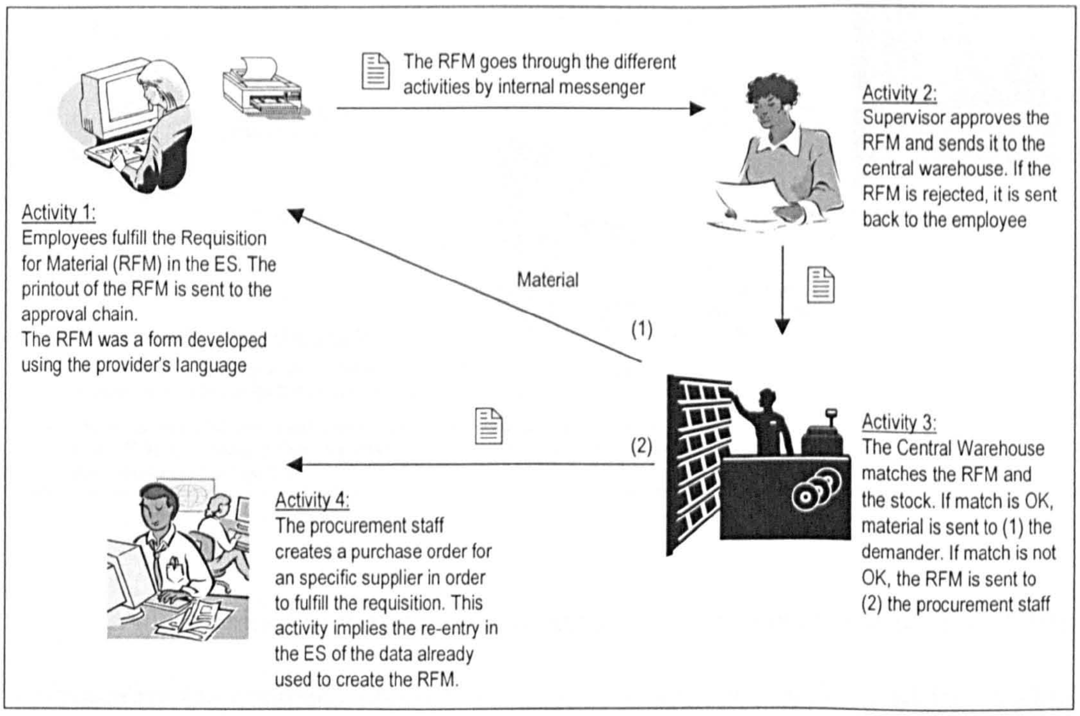
5.2.5 ES-Use

The ES implemented in CC was considered by users as being complex to use. Some of CC's users pointed out that "one needs to go through many screens to do a particular transaction". Although training was useful, many users argued that learning by "trial-and-error" was the best way to learn to use the system. Then, **learning cycle No. 4** acts here clearly as experiential learning. It is important to note that two particular mechanisms helped in this learning process in CC. First, users exchanged information and experience in order to tackle operational problems by sharing "tricks." Secondly, a help desk was created to answer questions about how to use the system. The latter was key in the case of regional warehouses and sales centres where users were relatively isolated, and unable to rely on the insights of colleagues. For instance, an end-user pointed out that she once called the help desk to ask how to reverse a mistake in the quantity of product registered in a transaction. Where there were recurrent doubts or questions, CC scheduled new training for specific sets of users. The **training learning loop** was activated. This loop encompassed both operational and conceptual training. That is, some users needed further training to know how to use the system and some users needed further training to understand how the system works and how the work of each user affects the rest of users. In fact, the latter was common in the first years of the process because the conceptual training was often poor in the initial end-user training activities. In the subsequent years CC paid more attention to the conceptual training as part of the end-user training activity.

The process of using the ES also allowed CC to increase conceptual understanding about the integration concept underpinning ES and the organizational needs associated with it. In CC there were several mismatches between the modelled and actual processes. These mismatches revealed the action of the **business adaptation loop** and the **system configuration and tailoring loop**. One of the remarkable examples of mismatch in CC related to the procurement of indirect materials. The mismatch here emerged because the ES had been tailored to follow the way CC was already performing this process. First, CC tailored the system to support a requisition for material (RFM) from departments to the central warehouse. This was not in the system's standard functionality.

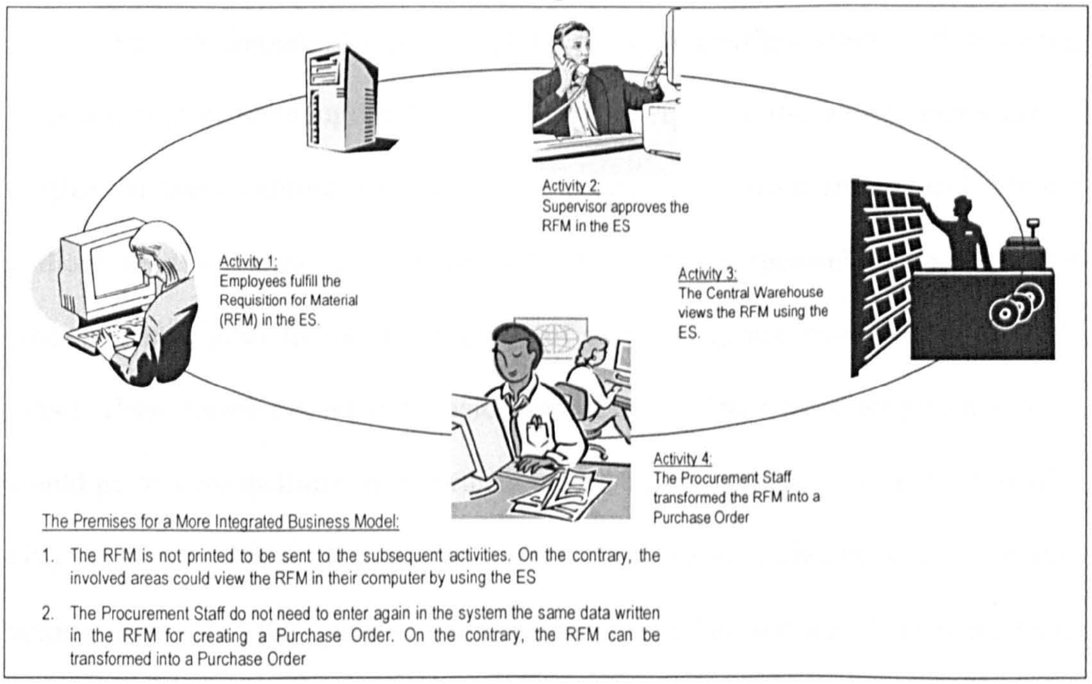
Secondly, this RFM was printed in order to follow an approval chain. This worked for goods supplied internally. However, if the required material was not available in the central warehouse, the printout of the RFM was then sent to the procurement department in order to create a purchase order to the respective supplier. This involved the re-entry in the system of the data previously used to create the RFM (see Figure 5.2.a). As one can deduce, this initial solution did not exploit the potential for ES to integrate effectively. On the contrary, in the Hammer´s (1990) language, CC had "just paved the cow paths." Over time, and as a consequence of using the system, key users understood the ES integration philosophy. It followed that a more integrated business model was developed and configured in the system by activating the business adaptation loop and the system configuration and tailoring loop (see Figure 5.2.b).

Figure 5.2.a The Procurement of Indirect Materials using the RFM - before the Loops



Other important evidence of these loops in CC related to the accounting and cost accounting systems. With reference to the accounting system, as CC's needs of information changed over time the accounting department had to reconfigure the system to add appropriate accounts or separate pieces of information in distinct accounts. To illustrate, after using the system's expenses functionality, upper-management required it be changed to support separate accounts as segregated as possible. Some mistakes were also found at this same time, which required running the **system configuration and tailoring loop**. For example, some advertisement expenses were configured to be automatically allocated to the maintenance expenses account after they were introduced. When the accounting staff discovered the mismatch, it was solved.

Figure 5.2.b The Procurement of Indirect Materials using the RFM - after the Loops



With reference to the cost accounting system, after using the manufacturing functionality the company learnt more about the system's options, which resulted in a review of the cost accounting model already implemented. That is, the **business adaptation loop** was activated. Given CC manufactures coffee with different specifications (i.e. different blends to produce distinct qualities), key users redesigned the model to record costs by batches of production. This motivated an organizational adaptation as well. Once a batch is completed, the production manager now has the responsibility of closing the batch in the system for determining the cost of finished goods. Because of this, the production area became a key element in completing the accounting cycle. Any delay from the production manager in doing this could affect the work of the accounting staff in preparing the monthly financial statements. The integration philosophy underpinning the ES had to be understood by all participants in this process. As the administration manager clearly stated: "If Edgar (the production manager) does not close the batches, we cannot close the period".

Another important example of the **system configuration and tailoring loop** was that of reducing the time of issuing cheques in the remote procurement centres. In these centres, CC buys itself green coffee from small local farmers without intermediaries (see Figure 4.1). Farmers go themselves to the CC's procurement centres to sell a few sacks of coffee (e.g. just one pick-up or small lorry). These farmers want to be paid immediately. If this were not possible, they would go to a competitors' procurement centre located next to that of CC. Initially, after the system was implemented, the time taken to issue a cheque was longer than before. Given that the speed of cheque-issue was a key service element for these farmers, users demanded improvements to this process. For them the system was worse than the former manual system. They proposed returning to the legacy manual system. To satisfy their needs CC had to modify the package to reduce the number of screens and steps needed in processing a cheque.

Finally it is important to note that many new reporting options were required by users after experience of system use. Hence the **system configuration and tailoring loop** was again set in motion. For instance, upper management asked for further specific reports according to new needs. One of these needs was to assist weekly control of company sales performance because of a severe recession inside the country. Thus the definition and monitoring of the weekly company's sales budget was required. For this, the IT department programmed a dynamic application using Excel and Visual Basic and interfaced it to the ES. This application was more flexible, provided better reach and was more user-friendly than using the ES directly.

The fourth and last loop from the ES-use activity is the **enhancement cycle**. As mentioned previously, this cycle encompasses two parts: rollout and implementation of new functionality. In the third year of diffusion, CC realized the rollout of the sales and distribution functionality into its twelve regional warehouses and sales centres. This was achieved over a period of nine months. The knowledge acquired here by key users was the action (know-how) of doing rollout from a methodological perspective. This occurred under **learning cycle No. 5**. Three applications of this cycle can be demarcated: 1) the rollout of the purchase functionality into seven remote procurement centres; 2) the rollout of the distribution & sales functionality into twelve distribution and sales centres; and 3) the rollout of the HHC's application and its interface with the standard ES into twelve distribution and sales centres. Key users recognized that "later rollouts were more straightforward than the earlier ones". For the year 2002, CC had planned to continue the rollout activity by doing the release of the service functionality (for registering and controlling the IT service orders) into all remote facilities.

When CC felt itself to have satisfied its original needs and objectives, new objectives and ideas emerged. As a result the ES diffusion followed an iterative and virtuous process of implementing further functionality. As the CEO argued, "the objectives moved in the degree in which our needs were satisfied; …first was the automation of our processes, …then the subsequent frontier became to use the system for realizing the measurement and control of performance indicators". Indeed, this part of the **enhancement cycle** has been applied several times in CC. During five years the following functionality was diffused throughout the company: financial accounting, manufacturing, materials management, service, distribution and sales, and DRP. On the other hand, applications developed by third-party providers (e.g. the HHC's application and the payroll) and by the IT department (e.g. definition and monitoring the company's sales budget) were implemented and connected to run in an integrated way with the ES. The latest iteration of this cycle was the development of a B2B initiative, which is likely to require the extension of ES functionality into CRM and e-procurement. For the next two years CC had planned the implementation of the following functionality of the system: transport operations, executive information system, statistical inventory control, assets management, activity-based costing (ABC), and localizations with reference to basic country-specific legal requirements (e.g. tax retentions and value added tax). With reference to the functionality of activity-based costing[8], key users thought it would motivate the re-modelling of several processes (e.g. cost accounting) already implemented and the further reconfiguring of the system. As ABC relies on a cross-functional and integrated view of the

[8] Activity-Based Costing is a method of measuring the cost and performance of the organization that is based on the activities, which the organization uses in producing its output (www.qpronline.com/abc/activity_based_intro.html)

organization, many key users considered that its implementation should occur after the whole ES diffusion was completed.

5.2.6 Summary of Activities

Table 5.1 describes the most important events related to the activities and cycles of the CC's diffusion process over time. The diffusion of ES functionality throughout the company occurred step by step in a continuous way. After nearly six years (two years in the first installation and four years in the diffusion process), CC had accomplished the rollout of the full functionality of its ES in support of the company's functions and business units. This encompassed the adoption of the functionality of financial accounting, materials management, distribution and sales, manufacturing, services, transport operations, and the interfaces with third parties' applications such as payroll, HHC, and business intelligence; and the rollout of them into the seven remote procurement centres, and into twelve regional warehouses and sales centres (see **enhancement cycle** in Table 5.1).

The process conforms in broad part to a wave-like pattern, as the new functionality selected at the outset of the enhancement cycle is launched to the organization. What follows can be interpreted as a complex series of perturbations or ripples as some functionality proceeds in a relatively straightforward way, whilst others are more complex and require amendment. The progress of the functionality of financial accounting and materials management, reveal the complex dynamic behaviours that are involved. The financial accounting functionality commenced in 1997-1998. It progressed forward to rollout in the second half of 1999. This rollout was complex, requiring the rework of a process model of the finance function. In the same period, the cost accounting system was remodelled influencing both the finance and manufacturing function (see process modelling as part of the business adaptation loop in Table 5.1). Meanwhile, the adoption of materials management functionality was already underway (see the 1st half of 1999). It proceeded in a relatively straightforward manner, although it did require the development of reporting options to meet the finance department's requirements (see feedback to system configuration and tailoring in Table 5.1). However, late on in the first half of 2002, this functionality was again under review as it was reconfigured to meet the demands of a new process model (see again feedback to system configuration and tailoring in Table 5.1). In the second half of 1999 conceptual training started to be given as result of deficiencies found in the way users operated the system. Since then, conceptual training was introduced as a compulsory component in end-user training activity (see end-user training activity in Table 5.1).

With this, CC had substantially remade itself around the model given by the ES system. The system had implications for role structures, procedures and policies, job turnover, skills levels of the workforce, and supply-chain relationships. On the other hand, the system has also been configured and tailored to fit company requirements (see system configuration and tailoring in Table 5.1). These continuous adaptive efforts have been realized by CC in order to maximize the effectiveness of the new technology.

Table 5.1 The ES Diffusion Process in CC: Events by Chronological Time Periods and Activities-Loops

		1997-1998	1999 (1st half)	1999 (2nd half)	2000 (1st half)	2000 (2nd half)
Enhancement Cycle	Selection of the new functionality for implementation	The financial accounting functionality in the factory The manufacturing functionality in the factory	The materials management functionality in the factory	The service functionality in the factory for IT service orders	The distribution and sales (D&S) functionality in just one of the remote D&S centres (Pilot)	
	Rollout of functionality already implemented			The functionality of financial accounting and materials management into the remote procurement centres		The D&S functionality into the rest of eleven remote D&S centres
Process Modelling & Org. Adaptation	As part of the sequence of activities	Modelling of the financial process Modelling the manufacturing process	Modelling the process of procurement & warehousing related to the materials management functionality	Modelling the service process related to IT service orders	Modelling the distribution & sales process - Role changes - e.g. sales assistants	
	As part of the business adaptation loop			Re-modelling the cost accounting system. Role changes in the manufacturing´s users.		
System Configuration & Tailoring	As part of the sequence of activities	Configuring the functionality of financial accounting and manufacturing Developing an interface between the ES and the legacy sales application.	Configuring the materials management functionality	Configuring the service functionality Development of reporting options to meet the IT department's requirements	Configuring the D&S functionality Development of reporting options to meet the warehouses & sales department's requirements	
	As part of the system configuration and tailoring loop		Development of reporting options to meet the finance department's requirements	Package modification for reducing the time of issuing a cheque Development of further reporting options to meet the finance and manufacturing requirements	Re-configuring the accounts structure to meet new organizational needs.	Development of further reporting options to meet the warehouses & sales departments' requirements Re-configuring the codes of clients in the master data
End-user training	As part of the sequence of activities	Operational training (i.e. how to operate the system) for the finance end-users	Operational training for the procurement end-users	Operational training of the service functionality for all end-users.	Operational training for the remote D&S centres' end-users Conceptual training of the integration philosophy for the D&S centres	Operational training for the D&S centres Conceptual training of the integration philosophy for the D&S centres
	As part of the training loop			Conceptual training of the integration philosophy to end-users already trained		

Table 5.1 (continued) – The ES Diffusion Process in CC: Events by Chronological Time Periods and Activities-Loops

		2001 (1st half)	2001 (2nd half)	2002 (1st half)	2002 (2nd half)
Enhancement Cycle	Selection of the new functionality for implementation	The Hand-Held Computers application (sales automation) in just one of the remote D&S centres. This application is from a third provider.	The distribution requirements planning (DRP) functionality	Application for the definition and monitoring of the company's sales budget. This was a development by the IT department.	Plan: Functionality and application to implement and/or develop over the next two years: transport, executive information, B2B, statistical inventory control, assets management, ABC costing, and localizations.
	Rollout of functionality already implemented	The D&S functionality into the rest of 11 remote D&S centres	The Hand-Held Computers application into the rest of 11 remote D&S centres	The service functionality in all remote facilities for registering and monitoring the IT service orders	Plan: The service functionality into all remote facilities for registering and monitoring the IT service orders
Process Modelling & Org. Adaptation	As part of the sequence of activities	Designing Sales Bonus Scheme (as part of the D&S functionality)	Designing the DRP model	Designing the sales budget model	Plan: Designing the models of transport operations and B2B.
	As part of the business adaptation loop	Changing the users' roles and responsibilities in closing accounts for issuing the monthly financial statements	Remodelling the process of procurement of indirect materials	Creating new procedures for helping in the auditing function. (e.g. developing a report for auditing the bills of sales issued vs. the actual bills)	Remodelling the process of procurement of direct materials
System Configuration & Tailoring	As part of the sequence of activities	Interface between the ES and the HHC application	Configuring the DRP functionality Programming add-ons for calculating the DRP's parameters according with the company's practices Designing a session to enter quickly the sales budget in order to run the DRP functionality Programming add-ons for calculating and reporting the sales bonus scheme	Programming an application for the company's sales budget using Excel & Visual Basic – interface with the ES Development of reporting options to meet the DRP model's requirements Re-configuring the MM functionality according with the ultimate model designed for the procurement of indirect materials	Plan: Configuring and tailoring the ES functionality related to transport operations and B2B.
	As part of the system configuration and tailoring loop	Interface between the ES and the legacy HR application Development of further reporting options to meet the sales requirements	Development of special reporting options to meet the upper management requirements (e.g. the weekly and monthly company's performance)	Development of reporting options to meet the procurement department's requirements	
End-user training	As part of the sequence of activities	Operational training of the HHC for the sales force and intermediaries	Operational training of the DRP functionality for the finished goods warehouse's end-users	Operational training of the sales budget application for end-users	Plan: Operational and conceptual training of functionality to be implemented
	As part of the training loop	Operational re-training for the D&S end-users in order to reduce deficiencies found through the help desk	Operational re-training for the manufacturing area's users	Conceptual training for new managers.	

5.3 Engineering Services Company (ESC)

ESC is a corporation based on a group of companies acting as cost-benefit centres responsible for their own results. They can be categorized into three main business units: Engineering, Procurement and Construction (EPC), Petroleum Operations (PO), and Telecommunications Operations (TO). These three business units operate independently within ESC but, despite this, the ES implementation was managed by a centralized team. The corporate CFO was assigned as the project leader. The way that ESC defined its implementation objectives and planned and performed its ES project suggests that it should be considered here as a single case.

5.3.1 Selection of the new functionality for implementation

As with CC, ESC began with the implementation of the financial accounting functionality as a central repository of all transactions in all of three business units. However, the major goal of this implementation was to: 1) reach a more accurate and faster corporate financial consolidation; and 2) gain access to detailed business information for making better business decisions. As the CFO pointed out "we had a lot of small systems without any connection between them, which originated data redundancy, inaccurate data, and a long time to develop any consolidated data; ...all of this caused the Executive Committee to think about how to sorted this problem out; ...we all wanted a new technological platform able to integrate and unify all our business units for having consolidated information." The financial control functionality was chosen to be implemented simultaneously alongside the financial accounting functionality. As the CFO also argued, "while the financial accounting functionality allows us to produce financial results and statements, the financial control functionality records the cost centres and cost accounting; ...each complementing with one another."

Once the financial accounting functionality was implemented in all business units, the ES provider invited ESC to participate as a pilot in the country for the implementation of payroll functionality[9]. The company accepted the challenge and this functionality (as a part of the human resources solution) was implemented in all business units. Later the training and personnel assessment functionality were also implemented. In addition, specific functionality was chosen for each business unit. For instance, the EPC unit asked to implement part of the project functionality, which alongside the financial control functionality would allow the company to record the costs of each project. The time recording functionality was also chosen to be implemented for registering and processing the work completed by the employees in each EPC project. Finally, parts of the sales and distribution functionality and the materials management functionality were chosen to be implemented in the other two business units.

5.3.2 Process Modelling and Organizational Adaptation

The first processes modelled by ESC were those of financial accounting and cost accounting. For this, a clear understanding of the organizational needs and the ES business practices was developed within **learning cycle No. 1**. EPC being a grid structure[10], the major organizational need was to measure costs of both project and

[9] This payroll functionality was a localization of the human resources solution with reference to basic country-specific legal requirements.

[10] A grid, or a matrix, structure in EPC retains both functional-based and project-based structures and imposes multiple reporting and planning requirements and responsibilities on managers. For instance, an engineer may be under the direction of both a functional engineering manager and a project manager.

functional areas. As the CFO pointed out, "we want to view the organizational results from the two sides of the matrix. For example, the return of the mechanical engineering department[11] and the return of a specific project." Key users learnt about the ES and its possibility of solving this need. The controlling functionality alongside the project functionality allowed key users to develop a virtual accounting drawn up in all dimensions, as they wanted.

As part of the first stages of the implementation process, ESC also tackled its billing process. Here a huge gap emerged between the organizational needs and the sales functionality. While EPC required to bill professional services (usually measured as man-hours), the system standard functionality offered, at that time, a narrow range of billing options (e.g. for manufactured goods). As a consequence, system tailoring was demanded by key users (see the <u>system configuration and tailoring</u> activity below). By running **learning cycle No. 1** again, a clear understanding of the billing requirements was achieved in order to model the process. Three billing schemes were designed for including all possible cases.

Another important organizational need emerged within **learning cycle No.1**: the collection, register, and processing of work completed by employees in each project. This requirement was one of the most important inputs for many business processes (e.g. billing, payroll, and costs accounting). Investigating how the system could tackle this particular need, key users chose to attend the provider's world conference and exhibition. This was held in the United States on 1997. There, key users found out about new time-recording functionality recently released by the provider. ESC became the first world implementation of this functionality. Although the functionality allowed the company to close the gap

[11] Departments are also measured and controlled according with the percentage of time effectively employed by their engineers working in projects.

between its organizational needs and system practices, implementing it was a big challenge. As it was new, the consultants did not have knowledge of its operation and, as a consequence, the **business adaptation loop** as a learning and improvement cycle was set in motion several times (see **business adaptation loop** in the ES-use activity below).

One of the most remarkable outcomes of **learning cycle No. 1** in ESC had been the development of its own modelling methodology. Given ESC had many procedures and diagrams that described its current processes; the aim had been to develop a methodology that would be able to translate this existing information into a map of processes. Thus, the methodology would translate heterogeneous information into a standard way of documenting the existing processes. As a consequence better understanding of the current situation was achieved. The resulting map would also allow key-users to do gap analysis between the own processes and the ES business practices.

Briefly, the ESC modelling methodology is able to model processes from the procedures and policies manual and diagrams that are already written or drawn. The methodology encompasses a validation process through undertaking interviews with key actors. The most important modelling issue is the description of the requirements of each activity. This is prioritized ahead of temporal analysis of the occurrence of events. Visio[12] software was used to draw the maps. The Administrative Systems Department (that is the department responsible for ES support) was the sponsor and owner of this methodology. They worked alongside industrial engineering students from a local university in developing it.

---

[12] Visio 32 is a trademark registered by Microsoft.

The methodology had been already tested in the procurement process that belongs to the EPC macro-process called engineering, procurement and construction (i.e. the core business). This procurement process had a set of powerful systems developed by the company many years ago, which had been considered one of the most important company's knowledge assets. In fact, users had shown resistance to change them. Mapping the process using the methodology allowed users to achieve better understanding of weaknesses and strengths from the current situation. Then a gap analysis aided key users to define where the ES could be inserted inside the process and how some interfaces between the current systems and the ES could work.

Finally, it is worth noting that the modelled processes caused organizational adaptation. Examples of this adaptation were: 1) changes in the human resources procedures and roles (e.g. substitution of several employees for just one in the process of running the payroll); 2) changes in procedures of collection, register and processing of timesheets (e.g. decentralization of the processing into remote offices). Users pointed out that they did not conceive in their mind the actual magnitude of changes that the ES could realize. As one of them argued, "you begin with a vague idea of adaptation, but you really understand the reality of this when you are embedded in the project; ...the organizational changes are many."

5.3.3 System Configuration and Tailoring

A number of examples of configuration and tailoring are available in the ESC study. For example, the system was configured to support the cost accounting model already modelled. In addition, the system was also configured to follow the company's payroll scheme. In the case of financial accounting, configuration was enough for reflecting the organizational needs inside the system. However, the system was tailored in other cases. Examples of tailoring were:

1) The development or adjustment of data outputs and reporting options for areas such as finance and human resources (e.g. adding fields to standard outputs).
2) The development of interfaces between legacy systems and the ES. For instance: a) using batch input into the ES from the legacy payroll system; b) using batch input into the ES from applications developed by the company to ease the entry of some sort of data – e.g. some expenses. In 2002 the company was evaluating the use of an interface between a project software system from a third-party provider and the ES.
3) Programming further functionality using the provider's language for billing man-hours.
4) Programming further functionality for calculating a specific value of remuneration according to the sort of employee in the payroll functionality.

As a result of **learning cycle No. 2** key users acquired the knowledge required to configure the system. Key users were able to give support on the functionality already implemented. However, they recognized that the configuration of new functionality may require further knowledge from ES external consultants. With reference to system tailoring, key users acquired the knowledge to carry out easier tailoring (e.g. developing new reporting options and some interfaces) but they did not have a complete knowledge for programming in the provider's language. The latter had to be realized by external consultants.

5.3.4 End-user Training

Users admitted that training was poor and undertaken very quickly during the first stages of the implementation process. For some users this was due to "the race of going live as soon as possible." This had negatively influenced the use of the system. Although they admitted deficiencies in both operational and conceptual training, this latter aspect seemed to be the worst affected. Many hands-on training sessions were carried out for end-users of the financial accounting and human resources functionality. However, no conceptual training was realized at these early stages. As a key user pointed out, "we should have met end-users in a room to explain the integration philosophy; …explaining that if she introduces a wrong value in the system, this will reflect in all processes related to it; ...we never explained (at that moment) how the information flows through the system."

For the ES project manager, a training method emerged from **learning cycle No. 3**: the four training levels for ES. According to her, the first is the conceptual level. This explains, amongst other things, how the company operates its own processes, what the master data refers to, and how the data flows through the system. No specific knowledge about the system is required to go through this level. After this, end users can learn the operational level for their specific areas. This level would encompass two key lessons: 1) to learn about your own area in the system; and 2) to learn about the relationships between your own area and the rest of the system's functions. For instance, for those users working in the accounts receivable area, trainers should teach both accounts receivable sessions and the relationships between accounts receivable and other areas or roles such as treasurer, billing, sales, and so forth. The third is the configuration level. Excellent users could become key users, which implies teaching them how to configure the system. Finally, those persons who know all about the previous levels should be considered as trainers and experts.

5.3.5 ES-Use

As with CC, users at ESC pointed out that its ES is unfriendly and difficult to be learnt and used. Some disliked the system because of its slow speed; others detested its displays (e.g. data entry screens and/or reporting screens), or commented negatively on the long path involved in doing any transaction. One of the key-users pointed out that "deficient training might have been responsible for this perception." Other set of users indicated, "training was deficient in terms of the quantity of knowledge delivered." Given this, an important part of the learning experience was in using the system over time. Users exchange "tricks" and their experience in using the system with one another, which allowed the company to speed up the learning process. The **learning cycle No. 4** acted here as experiential learning. Because of the deficiencies found in the first training activities, the **training learning loop** was also activated for some users.

In ESC there were several mismatches between the modelled and actual business processes. These mismatches activated the **business adaptation loop** and the **system configuration and tailoring loop**. With reference to the latter, the system configuration and tailoring loop, one simple and important example was that of completing fields or parameters in the accounting's master data. After using the system, accounting staff discovered that they were not able to analyze all transactions in each account. The system just allowed staff to view the account balance. This obviously did not satisfy the auditors and accountants' requirements.

Then the **system configuration loop** was activated to reverse this mismatch. They learnt that it was necessary to activate a specific indicator in the master data in order to realize this need. Similar mismatches occurred in other cases of accounting and they were also fixed.

One of the remarkable examples of mismatch in ESC related to the time recording process. Given the output of this process was considered a critical input to other processes (e.g. payroll, billing, and project management), three performance indicators were defined as important to be accomplished: 1) the processing time of timesheets; 2) the delivery time of the output into the internal clients; 3) the quality of data. After using the system, users found a huge gap between the modelled process and the expected performance (i.e. a mismatch). Then a learning and improvement cycle was set in motion lasting over three years to achieve the expected performance levels. Hence, improvements and adjustments in the process, procedures and the ES were realized in order to improve the data quality and reduce the processing and delivery time. ESC had already documented some of these improvements in an internal document as part of the company's quality management system. Evidence has been taken from this document to show how the **business adaptation loop** and the **system configuration and tailoring loop** operated here.

The time recording process encompasses three key sub-processes: the fulfillment and collection of timesheets, the recording of timesheets in the system, and the transfer of the output to other areas. Briefly, the modelled time recording process was as follows (see Figure 5.3):

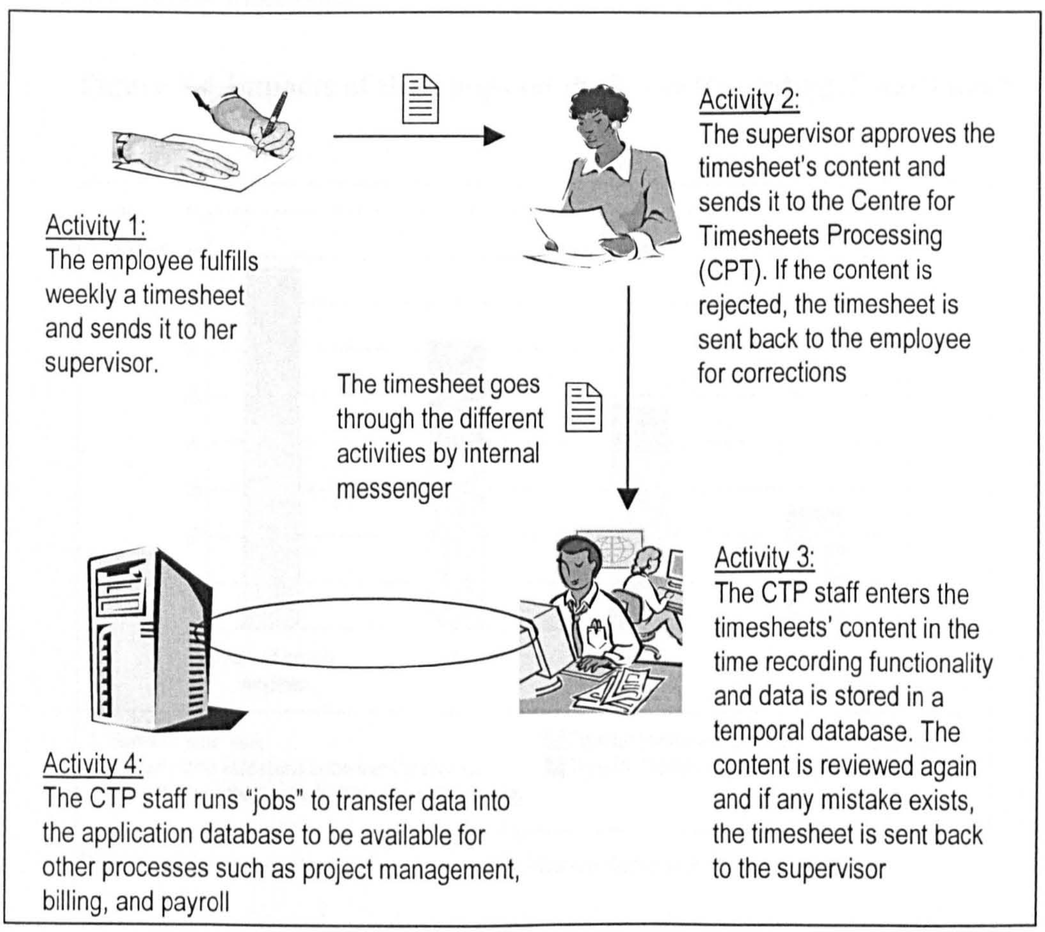
1) The employee fills a weekly timesheet and sends it to her supervisor.

2) The supervisor approves the timesheet's content and sends it to the Centre for Timesheet Processing (CTP) located in the finance area (whether the supervisor rejects the timesheet's content, this is sent back the employee for its correction, which implies increasing the process time).

3) The CTP staff enters the timesheet's content in the time recording functionality and data is stored in a temporal database (the staff reviews the content again and if some mistake exits the timesheet is sent back the supervisor – the data in the temporal database can be changed easily).

4) The CTP staff runs "jobs" to transfer data from the temporal database into the application database (where some troubles occur during the transfer process, the CTP staff have to diagnose and solve them).

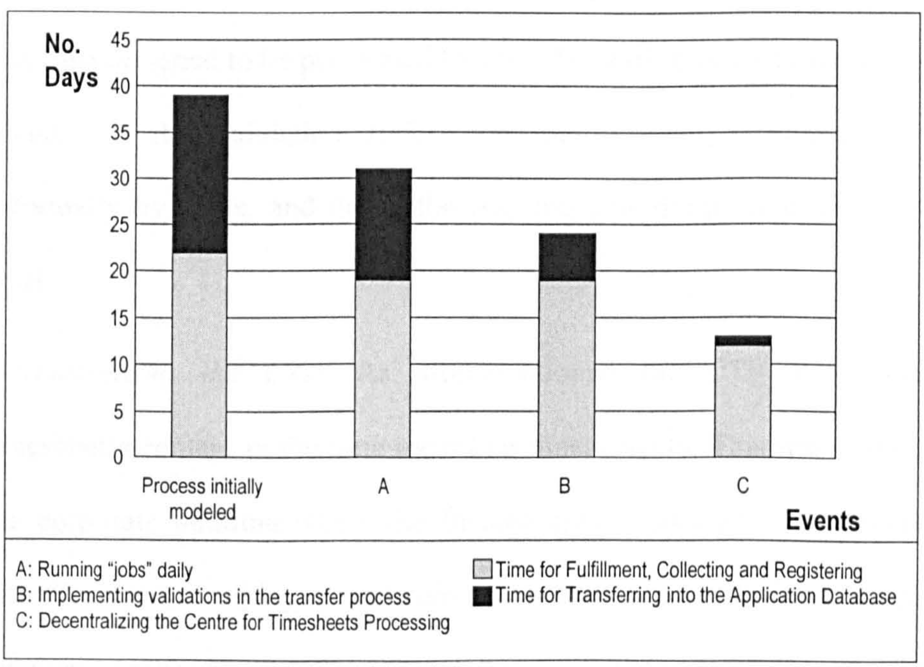
Figure 5.3 The Time Recording Process before running the Loops



The first time that ESC operated the process described above, it lasted almost forty days (see Figure 5.4). Mistakes were often found in the data. Given these mismatches between the process performance and the expected results, key users alongside technical specialists activated the **business adaptation loop** and the **system configuration and tailoring loop**. A set of improvements was carried out. Some examples are:

1) *Easier data entry*: A business adaptation and a system configuration loop were carried out in order to reduce the types of activities and cost centres in the controlling scheme already modelled. As a result of this, the amount of options that can be entered by users in the system was lowered in sixty percent. On the other hand, the system was tailored in order to use default field values. Then, the likelihood of recording incorrect data was reduced and the data quality was significantly improved.

Figure 5.4 Impacts of the Loops on the Time Recording Total Time*



*This graph has been adapted from company's internal documents.

2) *Implementing validations*: The system was tailored in order to run validations (using user-exits) for detecting mistakes in the data entry. A procedure to be performed by the CTP staff was also designed as a business adaptation in order to fix mistakes found after validations. As a consequence, the data quality was improved.

3) *Running "jobs" daily*: key users decided to run daily the data transfer process from the temporal database into the application database. This was because of the project area's need of having these values daily. Before this improvement there was not a regular transfer process, which originated the project area developed its own timesheet database. That is, a huge mismatch was evident: data redundancy whilst using an ES. Then a new procedure was released as part of a business adaptation.

4) *Implementing validations in the transfer process*: A "query" was developed using the provider's language in order to compare the data inside the temporal database and the data transferred into the application database. A procedure was also designed to be performed by the CTP staff in order to fix the mistakes found after this validation. Before this improvement, mistakes were found informally by users, and doing the tracking and fixing of errors were huge work.

5) *Decentralizing the CTP*: As aforementioned the CTP staff enters the timesheet's content in the time recording functionality. This was carried out in the corporate building where the finance area is located. They received the timesheets from employees and supervisors located in diverse areas inside and outside the corporate building. Some were quite remote and the collection time of timesheets by the CTP staff was very long, negatively affecting the total

time. An obvious improvement was to allow the remote areas to enter themselves the timesheets' content in the time recording functionality (see also the rollout activity below). Once the processing of timesheets in the ES was decentralized, the average total time was lowered.

6) *Implementing electronic timesheets and a workflow system*: ESC had already planned to implement an electronic timesheet and a workflow system in the near future. With this initiative, timesheets would be fulfilled electronically in the computer by employees and then sent electronically to supervisors for their approval, before finally their content was transferred into the application database through "jobs".

As a consequence of the improvements described above, the process time was lowered less than fifteen days (see Figure 5.4). ESC further expected to achieve a still better time as it was anticipated fulfillment-collection-recording could be improved still more by using a workflow system.

The last loop from the ES-use activity is the **enhancement cycle**. As aforementioned, this cycle encompasses two parts: rollout and implementation of new functionality. During the first year of diffusion, ESC realized the rollout of functionality of financial accounting and controlling into its all business units. The knowledge acquired here by key users was the action (know-how) of doing rollout from a methodological perspective. This occurred under **learning cycle No. 5**. As the project manager pointed out, "most companies within the three business units had similar financial practices and processes; ...we began configuring and implementing the smallest companies and later we ran the big one (i.e. EPC)." ESC applied also this learning cycle during the rollout of the time recording functionality into the EPC regional offices.

As with CC, when ESC felt itself to have satisfied its original needs and objectives, new objectives and ideas emerged. Thus the ES diffusion followed an iterative and virtuous process of implementing further functionality. The CEO argued, "our implementation objectives have moved according with our needs; ...first we needed urgently the automation and consolidation of our financial processes throughout the corporation, ...then the rest of processes were evaluated, ...now we are evaluating the possibility of implementing the ES in the project and operations processes (i.e. the EPC's core business)." The ES support manager also pointed out, "new needs are stated annually; ...based on this, an annual plan is released, which defines the functionality to be implemented or rolled out over the next months."

Hence, the **enhancement cycle** has been applied several times in ESC. During five years the following functionality was diffused throughout the corporation: financial accounting, controlling and human resources. On the other hand, specific applications have been diffused according with the specific needs of each business unit. Some examples of this are: 1) the sales & distribution functionality in the telecommunications unit, and 2) the functionality of time recording and materials management in EPC.

The last iteration of this cycle in the corporate context had been the implementation of the financial consolidation functionality. But doing it required the implementation of the functionality of assets management and inflation adjustment[13]. Implementing these three functionalities for all business units lasted about a year. In 2002, the corporate plan encompassed, amongst others, the implementation of a business intelligence application from a third-party provider.

[13] Inflation Adjustment is a localization of the financial solution developed by the provider with reference to basic country-specific financial legal requirements.

The application's provider had already developed the required interface to exchange data with the ES. In fact, ESC was expecting that this application go live at the end of 2002.

In the EPC context, the next iteration would be the implementation of the materials management functionality and a project for handling the EPC projects. It is worth noting here that EPC had already implemented a part of the materials management functionality for handling a specific EPC project. This was done in partnership with an American EPC Company. In fact, this company asked ESC using a part of the ES (this partner had the same ES package) for handling the process with the same business language and sharing data easily. In 2002, EPC also expected to implement a new functionality recently released by the provider: the flexible billing functionality. After waiting several years, the provider's new functionality is likely to solve the huge gap between the company's billing process and the ES functionality.

5.3.6 Summary of Activities

Table 5.2 shows the most relevant events related to the activities and cycles of the diffusion process in ESC over time. After nearly six years, ESC had partially completed the implementation of the full functionality of its ES in support of the company's functions and business units. Up to 2002, the ES implementation had encompassed the adoption of the functionality of financial accounting, controlling, time recording, payroll, training, financial consolidation, financial localization, and third parties' applications; and the rollout of financial accounting, controlling, payroll and time recording into the rest of business units and regional offices (see enhancement cycle in Table 5.2). However, the operation and management of the EPC projects was still being performed using legacy systems. It was in the second half of 2002 when the company selected this process to be tackled. Given that this process was considered the ESC core business, this fact meant an important delay in the diffusion process.

By looking at Table 5.2 one can notice that the **business adaptation loop** and the **system configuration and tailoring loop** occurred in a continuous manner over the six years. Adjustments and changes followed after the initial implementation. For instance, changes in the controlling model (see business adaptation loop in the second half of 1998 in Table 5.2) or developing reporting options to meet the users' requirements (see the system configuration and tailoring loop in Table 5.2). These continuous adaptive efforts had been realized by ESC in order to maximize the effectiveness of the new technology on the processes already touched by the system. However, the **enhancement cycle** was not continuous. Between 1999 and 2000 no functionality was selected to be implemented. Then the spreading of the system throughout the company was moving slower than the adaptation loops of functionality and processes already implemented.

Table 5.2 The ES Diffusion Process in ESC: Events by Chronological Time Periods and Activities-Loops

		1997	1998 (1^{st} half)	1998 (2^{nd} half)
Enhancement Cycle	Selection of the new functionality for implementation	1) The FA and CO functionality in some companies; 2) the AM functionality for recording the rate of depreciation; 3) the (D&S) and (MM) functionality in the Telecom Unit; 4) the time recording functionality in the EPC unit; 5) part of the project functionality needed to handle cost centres alongside FA and CO in the EPC unit.		The HR functionality (to handle the payroll process) in some companies
	Rollout of functionality already implemented		The FA and CO functionality into the rest of companies.	The HR functionality into the rest of companies of the all units.
Process Modelling & Org. Adaptation	As part of the sequence of activities	Modelling: 1) the financial and controlling processes; 2) the billing process (man-hours); 3) the time recording process (Changes in procedures of collecting, registering and processing of timesheets); and 4) parts of the sales, materials mgmt, and project processes.		Modelling the payroll process Change of roles in the HR area. Change of procedures in order to fit the ES (e.g. registering of holidays and permissions to leave the office).
	As part of the business adaptation loop			Changing the controlling model by reducing the types of activities and costs centres in order to ease data entry in the time-recording functionality.
System Configuration & Tailoring	As part of the sequence of activities	Configuring the FA and CO functionality. Programming in the ES's language a solution for the billing process Configuring the time recording functionality and configuring parts of AM, CO, MM, D&S	Configuring the FA and CO functionality.	Configuring the HR (payroll) functionality Programming further functionality for calculating a specific value of remuneration according to the sort of employee in the payroll functionality
	As part of the system configuration and tailoring loop	Troubles were fixed in the billing application. The development was cancelled. New billing functionality would be release by the ES provider Development of reporting options to meet the users' requirements using the FA functionality.	Completing adequately some fields within the accounting's master data Developing user-exits to use default field values in the time recording functionality	Developing user-exits to run validations in the data entry in the time recording functionality Development of HR reporting options to meet users' requirements
End-user training	As part of the sequence of activities		Operational training for finance and accounting end-users. - Operational training of functionality of MM, D&S in the telecom unit. - Poor conceptual training	
	As part of the training loop			Retraining finance end-users in the FA functionality according to the deficiencies found.

Table 5.2 – continued. The ES Diffusion Process in ESC: Events by Chronological Time Periods and Activities-Loops

		1999	2000	2001
Enhancement Cycle	Selection of the new functionality for implementation			Part of the MM functionality for EPC projects – it was required by a project partner. The HR functionality (to handle the training) The localization of Inflation Adjustment -The financial consolidation functionality – and completing the AM functionality to work adequately with Inflation Adjustment and Financial Consolidation
	Rollout of functionality already implemented		The time recording functionality into the EPC regional offices	
Process Modelling & Org. Adaptation	As part of the sequence of activities			Modelling: 1) part of the procurement and payment control processes in the EPC unit; 2) training process; 3) financial consolidation process; and 4) inflation adjustment process.
	As part of the business adaptation loop	New procedures and roles to fix mistakes that emerge after validating the recorded data in the time recording process	New procedures and roles to run daily the data transfer process in the time recording process Decentralizing the Centre for Time Processing	New procedures and roles to fix mistakes that emerges after validating the transferred data in the time recording process
System Configuration & Tailoring	As part of the sequence of activities	As a consequence of introducing the HR functionality, it was necessary to reconfigure some parameters in the functionality of time recording and financial accounting		Configuring part of the MM functionality to handle the procurement and payment control processes for EPC projects. Configuring the HR functionality (training); the functionality of AM, Inflation Adjustment and Financial Consolidation.
	As part of the system configuration and tailoring loop	Developing a front-end application for entering some types of expenses and then transfer them to the ES through "jobs"	Developing a "query" to validate the data transferred to the application database from the time recording temporal database Programming a further functionality for allowing inflation adjustment of purchase orders in the MM functionality. Development of reporting options to meet the users' requirements using the MM functionality.	Development of reporting options to meet the users' requirements using the inflation adjustment functionality. Fixing the report of tax retentions for adding further fields
End-user training	As part of the sequence of activities	Operational training for HR end-users in all units. - Training in how to use the office tools for the HR end-users - Poor conceptual training		Operational training for materials end-users in the EPC unit. Better conceptual training was activated
	As part of the training loop			Retraining HR end-users according to the deficiencies found.

Table 5.2 -continued. The ES Diffusion Process in ESC: Events by Chronological Time Periods and Activities-Loops

		2002 (1st half)	2002 (2nd half)
Enhancement Cycle	Selection of the new functionality for implementation	The business intelligence functionality from a third-party provider The resource-related billing functionality	Plan: The functionality of project and MM to handle EPC projects The HR functionality (to handle personal assessment)
	Rollout of functionality already implemented		
Process Modelling & Org. Adaptation	As part of the sequence of activities	Designing Performance Indicators as part of the ISO 9000 requirements Modelling scenarios of billing.	Plan: Modelling 1) the procurement and project processes in the EPC unit; and 2) personal assessment process.
	As part of the business adaptation loop		Plan: New procedures and roles to register, approve, and transfer data in the time recording process as a consequence of a workflow system
System Configuration & Tailoring	As part of the sequence of activities	Three developments (user-exits) to enter data in the Resource-Related Billing functionality. Evaluating the possibility of an interface between project software from third-party provider and the ES.	Plan: Configuring 1) the functionality of project and MM; and 2) the personnel assessment functionality
	As part of the system configuration and tailoring loop	Plan: Developing interfaces and jobs for introducing a workflow system in the time recording process	
End-user training	As part of the sequence of activities	Operational training of the functionality of Business Intelligence and Resource-Related Billing for end-users in the EPC unit Operational training of functionality of Assets Management, Inflation Adjustment and Financial Consolidation for end-users in the EPC unit	Plan: Operational training of the project, MM functionality for the EPC's end-users Operational training of the personnel assessment functionality for the HR end-users Operational training of the workflow system for the EPC's end-users
	As part of the training loop		

5.4 Chemical Products Company (CPC)

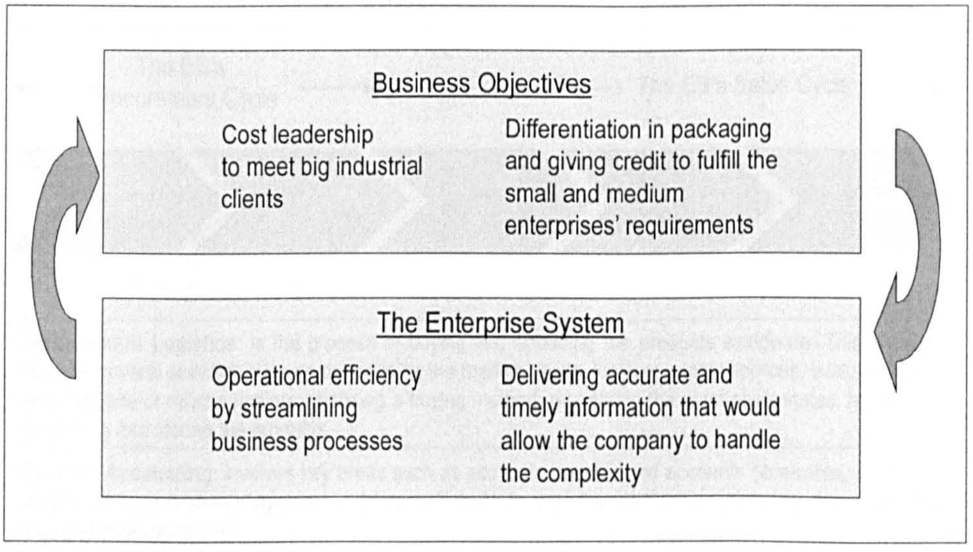
As mentioned, CPC is in the chemical distribution business (see the section 4.3.2). The ES experience of CPC can be divided in two well-defined periods of time. The first one between 1996 and 2000 in which the company carried out a poor implementation characterized by unfavourable contextual issues and inexpert ES technical support. Because of this, the ES achieved modest diffusion during the period. The second one between 2000 and 2002 in which, after a merger between CPC and a multinational company, the ES took a more relevant role and the diffusion process was considered the main objective for achieving better organizational performance. Given this, the internal diffusion process in CPC is explained here through two parts in order to reflect the specific characteristics of both periods of time.

5.4.1 The First Period: 1996-2000

Early in 1996, CPC decided to implement an ES because upper-management was convinced that this sort of application would support its business strategy. Briefly, the company had established two explicit business objectives: 1) cost leadership to meet industrial clients with requirements of high volume (bulk liquids) and low price - mainly big companies in which the CPC's products represented high percentages of their costs; 2) differentiation in packaging (e.g. barrels, sacks and smaller containers) and giving credit to fulfil the small and medium enterprises' requirements. It is worth noting here that most of goods sold by CPC are chemical commodities. Because of this, the company often competes in price war. Given that the margin is low, CPC has to be efficient in its own processes or has to find ways to differentiate itself from other competitors in order to sell with better margins.

The adoption of ES aimed to support the first objective by streamlining the business processes (operational efficiency). At the same time, the ES would encourage the second objective by delivering accurate and prompt information that would allow the company to handle the complexity of its differentiation strategy – e.g. handling an expansion of the accounts receivable. Figure 5.5 shows the alignment attempted. There were also further tactical reasons to invest in a new technological platform: 1) the company was having many technical troubles with its legacy systems; 2) the existing systems were not able to support adequately the growth of the business; in fact, operational troubles were originating delays in having timely financial statements as well as overlong delivery times.

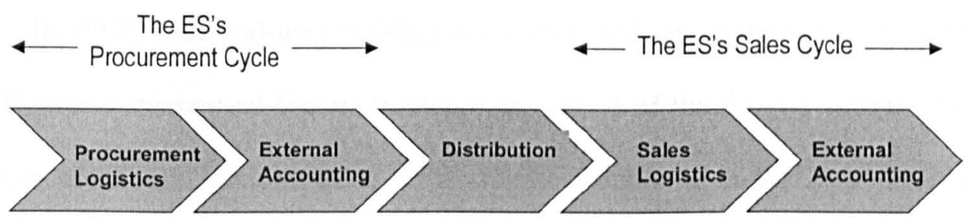
Figure 5.5 Aligning the ES and the CPC's Business Objectives



In late 1996, CPC had already bought an ES. The first activity was selecting the new functionality for implementation. The financial accounting, sales and distribution, and materials management functionality were implemented in order to support most of the four key CPC's processes: procurement logistics, external accounting, distribution, and sales logistics. Key-users also identified these processes as being part of the two ES business cycles: the procurement cycle and the sales cycle (see Figure 5.6).

Once the functionality was chosen the first iteration of the process modelling and organizational adaptation activity occurred. This iteration was undertaken under the premise that the company would follow the defined system practices. That is, processes were modelled according to the business processes embedded inside the system rather than considering the company's specific requirements. As a consequence, no system tailoring was developed as part of the system configuration and tailoring activity. The latter was limited just to set parameters in the package.

Figure 5.6 The CPC's Business Processes and The ES's Business Cycles



Procurement Logistics: is the process of buying and obtaining the products worldwide. This process involves several activities such as determining the market needs, locating supply sources, evaluating and selecting one or more suppliers, choosing a buying method, monitoring the purchase's status, receipting, evaluating and storing the products.
External Accounting: involves key areas such as accounts payable and accounts receivable, which are closely linked to cash management and forecasting. As in any other distribution company, this is the vital business process in CPC.
Distribution: refers to replenish products (only those liquids in drums) into regional distribution warehouses from central warehouse.
Sales Logistics: involves three key sub-processes: customer request for quotation (RFQ) processing, customer sales orders (CSO) processing, and delivery processing.

It is important to note that some key-users became disappointed over time because they found that the business practices embedded inside the system did not reflect some of their organizational needs. Although they warned consultants and upper-management about future troubles in the day-to-day operations, the decision seemed to be going ahead as planned. There were two reasons for this. Firstly, according to some users, "the motivation of having the system up and running in order to fix all the existing organizational troubles, prompted the upper-management to bet on an accelerated implementation; ...but this implied doing an implementation as simply as possible." Secondly, other users seemed to agree, "consultants did not know enough about the system to answer all specific users requirements." As a consequence of all of these facts, consultants undertook almost all diffusion activities (i.e. modelling, configuring, and training) during the first implementation attempt. Key-users were reduced to answer the consultants' requirements.

In 1997, once end-user training was completed, the system was ready to go live. However contextual factors hindered the outset of the ES-use activity. Some of these contextual factors were: 1) a chaotic finance area that was unable to release reliable financial statements; 2) some key-users were focused totally on the task of producing financial statements; 3) some key-users were unmotivated because the system did not reflect their requirements; 4) three functional managers and other key employees resigned as a consequence of a stressful organizational climate. One functional manager pointed out, "the company was embedded simultaneously in many operational troubles and in an ES project; ...the climate became hard at that time." In June 1997 the CEO decided to cancel the initiation of the system until the organization achieved a stable situation. Hence the financial staff focused on producing financial statements and the operations staff concentrated on improving the delivery time and client service. According to a consultant, "the system was ready to be used by the company; ...the procurement and sales cycles were already modelled and configured and end-users trained; ...whenever the company was decided we could have turned on the system."

Early in 1998 CPC revived the ES project and the system quickly went live. Some re-training was carried out in order to refresh knowledge already acquired. As new functional managers took responsibilities in the company, they were also incorporated as key-users. Few technical specialists were available in the job market at that time. Then the company recruited a young person with little product knowledge, but whom they expected could quickly learn and give internal support to end-users. Once the system began being used in earnest, key users detected many *mismatches* between the modelled processes within the system and the actual processes. Their early warning became real. None of the expected benefits were being achieved. According to a functional manager, "the system seemed to have just automated some tasks, but much had to be done in order to reach better coordination between business areas."

The **system configuration and tailoring loop** was activated, but just for programming applications or developing solutions in third-party providers' packages. For instance, Excel[14] was used for creating reports and showing data to remote warehouses. After two years dealing with the system, CPC had limited technical and functional knowledge of its ES. Some key users had gone, others did not participate in the key activities (modelling and configuring) as a learning mechanism, and the technical specialist did not participate in the process. During

[14] Excel is a trademark registered by Microsoft.

the subsequent two years (1998-2000) the internal diffusion and learning process of the ES in CPC occurred in an insufficient way. This was reduced to develop data output or reporting options. Many unresolved problems were neglected. A period of congealment occurred.

5.4.2 The Second Period: 2000-2002

After a huge personnel turnover, it was remarked, that the CEO seemed to be the only person who had stored any learning for the company. For him, "ES have high knowledge barriers; ...because of this, consultants are the most important component in the beginning of the process; ...in our experience consultants had little knowledge of the ES and little functional experience; ...another component is the key users, they have to be motivated for undertaking this project during a long time." The CEO wanted to start the ES project again, but he was waiting for stable contextual factors. He was aware of the system was "installed more than implemented." Still, in his words, "I really wanted to take advantage of the ES capabilities".

In May 2000, CPC and a multinational chemical company announced they would merge their chemical distribution business units in order to combine their assets and customer base. The new joint venture company was planned to be jointly owned and operated by the two partners. The main goal of the new company was to achieve economies of scale by eliminating redundant operating costs such as offices, storage facilities and personnel. The merger created the second largest chemical distribution business in the country. As a consequence of this big change, some part of the personnel was moved to distinct roles, some managers took new responsibilities, and, as with other mergers, downsizing occurred. Six months after this event, the new company validated the business strategy already explained above and retook the ES project as a vital driver for the company success.

Having learnt from the early mistakes, the CEO decided to pay more attention to consultants. The aim of achieving long and stable relationship with experienced consultants was paramount. An ES outsourcing agreement was signed with a well-known local firm. The company defined two clear objectives: 1) to optimize the functionality already implemented and 2) to deploy the system throughout the company. From the Diffusion Model perspective (see Figure 5.1), the company activated the **training loop**, the **system configuration and tailoring loop**, the **business adaptation loop**, and the **enhancement cycle** from the <u>ES-use</u> activity.

5.4.2.a Process Modelling and Organizational Adaptation

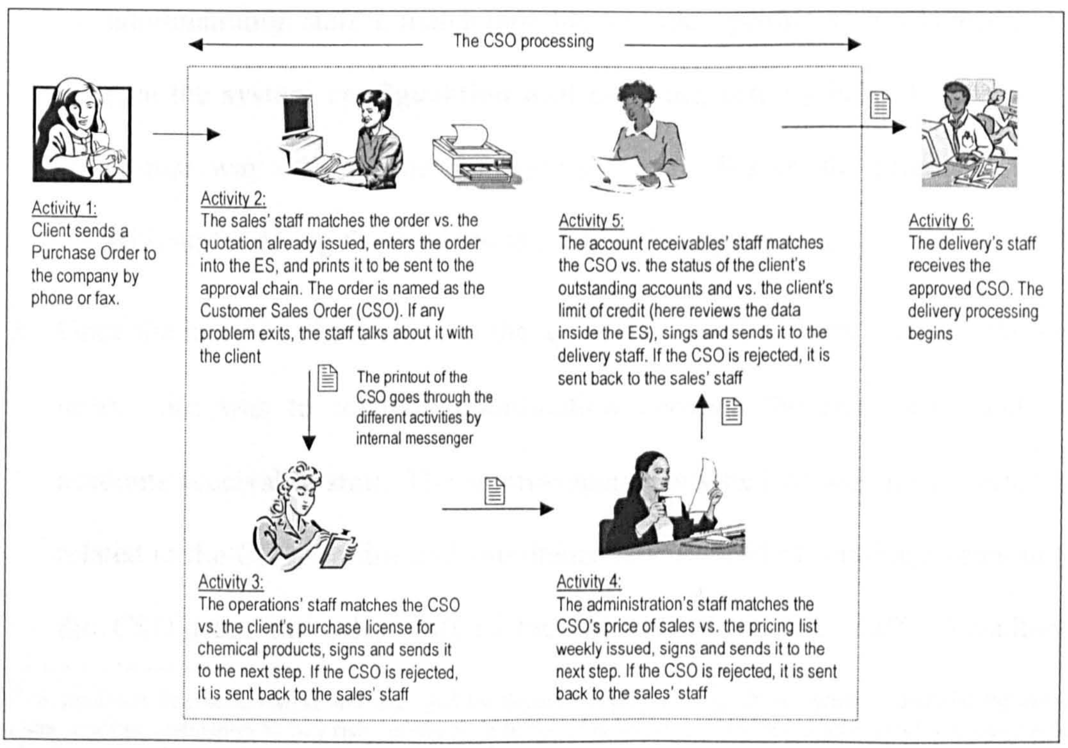
After using the system, *mismatches* were found between the modelled processes and the actual processes. This activated the **business adaptation loop**. With experienced new consultants and motivated new key users, **learning cycle No. 1** was set in motion. Firstly key users understood their own organizational needs and the existing processes' weaknesses. A better set of consultants provided enough product knowledge. Given this, modelling occurred again for the sales and procurement cycles that were already designed.

The Sales Cycle

The most remarkable example of mismatch in the sales cycle related to the customer sales order (CSO) processing. The major organizational need for the sales cycle was stated as assuring a cycle of 24 hours between the reception of the CSO and the delivery of goods to the customer's warehouses. To achieve this objective, the company had to improve some weaknesses in the CSO processing already modelled. Some of these weaknesses and the resultant improvements were as follows:

1. As can be seen in Figure 5.7.a, the system was not coordinating the work between distinct areas. The CSO was printed and sent through the rest of activities as a physical document. This shows a low understanding of ES integration concept from the former key users who designed the process in this way.

Figure 5.7.a The CSO Processing in CPC - before running the Loops



2. As can be seen in figure 5.7.a, the process seems to have an excess of checking activities (activities 3, 4, and 5). Key users questioned all these activities. As a result of this questioning, the activities 3 and 4 were changed:

   - Activity 3 was assigned to the sales staff, whom should now match the client's purchase license[15] vs. the CSO before entering the CSO into the system. The company had also planned to develop an application for automating the register and storage of these purchase licenses (see the **system configuration and tailoring activity** below).

   - Activity 4 was eliminated. Given the company wanted a tight control on the sales price given by sales representatives to clients, the administration staff checked the price of each CSO vs. the pricing list issued weekly (i.e. activity 4). However this procedure influenced negatively the sales cycle time. Because of this, the procedure was eliminated from the process. Instead, a new reporting option was developed for allowing the administration staff to match monthly the sales' profit vs. the planned profit (see the **system configuration and tailoring** activity below). This was a similar way of checking the price of each CSO vs. the pricing list; but without hindering the speed of the day-to-day operations.

3. Once the number of activities in the approval chain had been reduced, the key users' aim was to improve coordination between the sales staff and the accounts receivable staff. The improvement consisted of sharing information related to the CSO, on line and simultaneously, instead of sending a printout of the CSO from the sales staff to the accounts receivable staff. Consultants

[15] A purchase license is issued and managed by Security Agencies (e.g. DEA, Army or Judicial Police) in order to allow companies to buy risky products in terms of national security (explosives) and/or drugs traffic. This license indicates what types of chemical products can be acquired by the company according with its own production process and the quantity allowed to be bought in a period of time.

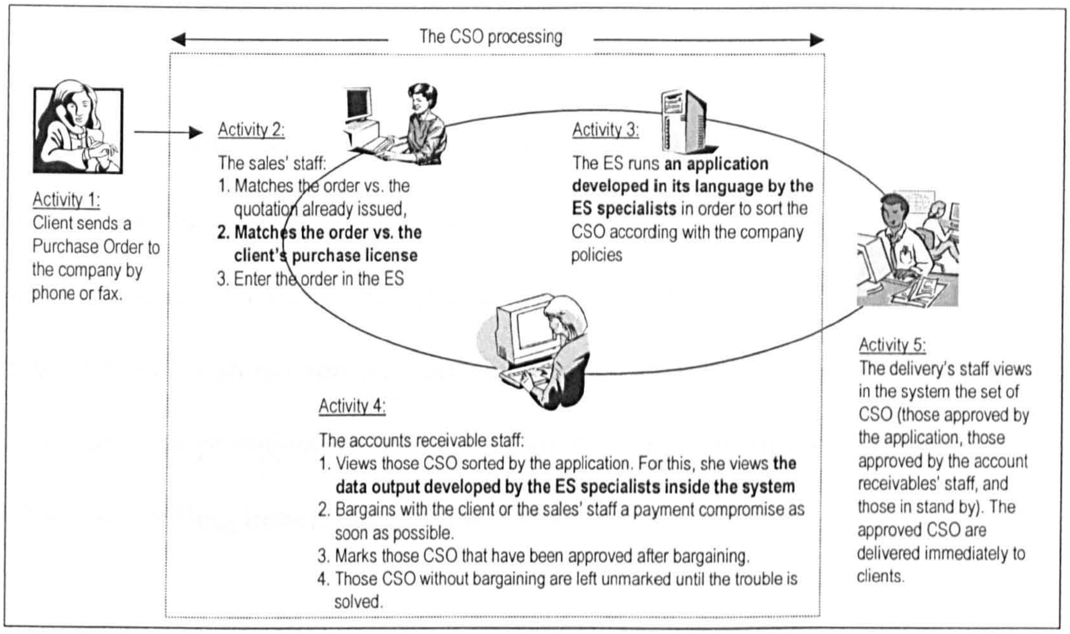
designed a special data output in which the accounts receivable staff could check and mark each CSO according to the client's limit of credit and outstanding accounts (see the **system configuration and tailoring** activity below). A marked CSO meant that it could be processed by the delivery staff, which was able to view the same data output.

4. To help the accounts receivable staff in its work, upper-management defined the Limit of Credit and Accounts Receivable Policy, which gave guidelines for approval processing. The system was configured and tailored in order to follow this policy (see the **system configuration and tailoring** activity below)

Figure 5.7.b shows the resultant process after running the **loops** in the CSO processing. As can be seen, a more efficient and simpler process was modelled. By reducing the number of activities and using the ES as coordinating mechanism (instead of the printout of the CSO), the time had been significantly reduced. The modelled process brought both organizational adaptation and system tailoring (see the **system configuration and tailoring activity** below). With reference to organizational adaptation, changes in roles and new procedures and policies emerged. Similar further adjustments were realized in the other two sales logistics' processes (customer request for quotation processing and delivery processing) in order to achieve a cycle time of twenty-four hours.

After the new process commenced operation, the company created an auditing team in order to assure the process is kept under the parameters of design. This team was constituted by some key users from the sales area. They would work temporarily during the first weeks of running the process. The idea was to avoid possible deviations arising from employee change resistance or any process deficiencies. For this, the team designed a scheme of signals, based principally on metrics, which might indicate whether deviations were occurring. Examples included average cycle time and the number of occurrences of back-orders.

Figure 5.7.b The CSO Processing in CPC - after running the Loops

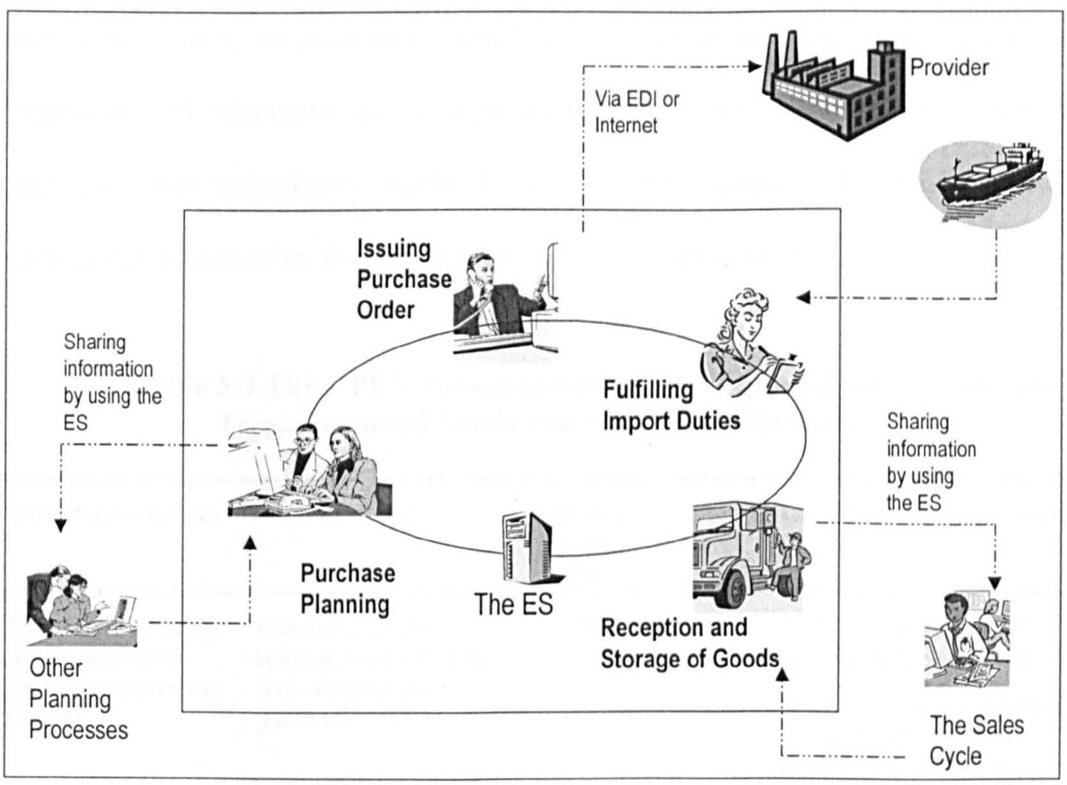


As a consequence of this work, the **feedback loops** were set in motion again. For example, deficiencies were found in the level of product knowledge of end users. Then, the **training learning loop** was activated. In addition, the team adjusted some roles in order to streamline the process. For instance, the new process had considered that goods returned by clients were recorded in the system by the delivery staff. This was the way CPC had traditionally carried out the task. However, in the ES this task is related to the sales functionality. This is because the system considered any return as reversing its CSO. Then as entering a CSO was undertaken by the sales staff, a return should also be carried out by them. Moreover, as delivery and sales areas required a tight coordination beyond sharing information through the ES, the layout of departments in the building was changed in order to allow delivery and sales areas to be contiguous. The use of small containers helped to move forms and documents (e.g. returned invoices) between both areas.

The Procurement Cycle

The procurement cycle encompassed four processes: 1) purchase planning, 2) issuing purchase orders, 3) fulfilling import duties, and 4) reception and storage of goods. Figure 5.8 shows the general business model designed by the key users. Figure 5.8 also shows the relationship between these processes and other internal processes and providers. In the case of goods bought from national providers, the phase of fulfilling import duties is not carried out.

Figure 5.8 The CPC's Procurement Cycle - after running the Loops: The Four Key Processes and Their Relationships with Other Processes



As part of the modelling activity, key users and consultants carried out a gap analysis between the organizational needs and the ES functionality (see Table 5.3). Both roles defined the weaknesses of the existing processes. Then, key users pointed out fundamental organizational needs related to each weakness in terms of requirements asked of the system. Later the ES specialists matched each organizational requirement vs. the ES functionality. This task encompassed the definition of a gap level. That is, defining how much the system could satisfy the specific requirement. A three-gap level was set out: "one" meant the system satisfies very well the need and implies just configuring the functionality; "three" meant the system satisfies partially the need and minor tailoring can be realized in order to close the gap (e.g. adding field to data outputs); "five" meant the system does not satisfy the need at all and major tailoring need to be realized in order to close the gap (e.g. programming further functionality). When this latter case occurred, the company could re-analyse its own processes in order to change its practices. Hence, organizational adaptation could occur. Finally, an agenda of organizational adaptation and system configuration and tailoring was agreed by key users and consultants. Table 5.3 shows ten examples of the gap analysis carried out as part of modelling the new procurement cycle.

Table 5.3 The CPC's Procurement Cycle: Gap Analysis between the Organizational Needs and the ES Functionality

Existing Situation	Need	Is this in the ES?	Gap Level	Gap Analysis & Decision
Manual processing of the requisition for indirect material (RFM)	Functionality for running the RFM and transforming it into purchase orders	No	5	To satisfy this need the system must be tailored Decision: to keep carrying out the process in a manual way or find an application from a third-party provider

Existing Situation	Need	Is this in the ES?	Gap Level	Gap Analysis & Decision
No data related to suppliers is available.	Functionality for the recording of suppliers and all of their data (products, delivery time, price, and quality). Integration between the products' master data and the suppliers' master data	Yes	1	The functionality is available in the ES Decision: Select this functionality for implementation
Deficient purchase planning of goods and packaging material. This originates high costs because of the purchase of small quantities, instead of bundles	Functionality for the planning of purchase. The model should encompass the following inputs: the existing inventory levels, sales budget, and the provider's delivery time.	No	3	Although the ES does not have exactly this functionality, it is possible to adapt the model of Master Production Schedule (MPS) to be used as a purchasing schedule. Decision: Carry out pilot tests to evaluate this option
Manual processing of the request of quotation	Functionality for the recording of the request of quotation and the conversion of it into a purchase order	Yes	1	The system satisfies very well this need. Decision: Select this functionality for implementation
Manual processing of the approval of purchase orders	Workflow functionality for the routing of purchase orders into the supervisor	No	3	Although the system does not have this functionality, the ES specialists propose to add a field in the purchase order form to be filled by the supervisor as a signal of approval. This implies a minor system tailoring Decision: Tailor the system
Purchase Policies not documented neither recorded inside the system	Configuring the system to carry these policies	Yes	1	The system can be configured easily to keep the company's purchase policies Decision: Select this functionality for implementation
Purchase Order is sent to the provider by fax	Functionality for sending electronically the purchase order to those providers with an adequate platform (e.g. using EDI or Internet)	Yes	1	The system satisfies very well this need. Decision: Select this functionality for implementation

Existing Situation	Need	Is this in the ES?	Gap Level	Gap Analysis & Decision
Poor coordination between the areas of procurement, treasury and operations, which causes long payment time and unplanned reception of goods	Sharing information between these areas in order to improve coordination and business performance	No	3	The ES specialists suggest to create a data output which allows users to view all purchase orders issued and their expected date of arrival Decision: Tailor the system
Quality inspection is not carried out in the reception of goods	Block the reception until the quality department approves the arriving goods	Yes	1	The system satisfies very well this need. Decision: Select this functionality for implementation

Further Evidence

Another significant example of the **business adaptation loop** was that of remodelling the company's accounts plan. This need emerged as a consequence of the upper-management's request to have financial statements that reflected the different profit centres (i.e. the regional operations). Since the first implementation the accounts staff issued these statements using Excel because it was impossible to do by using the ES. Key users learnt that one could define the accounts structure in the system based on dimensions. Because of this, it was possible to have financial statements and results for regional operations by using the ES.

Other processes that were also remodelled were those of costing, pricing and inventory management. These processes followed the system practices because they were considered better than those existing in the company. The costing was based on calculating the cost of each good according to the own good cost, plus fixed charges related to it. Such fixed charges might be import and other administrative expenses, packaging, and distribution into regional warehouses.

The system was configured here following the data provided by key-users. In fact, they had to simulate different scenarios of more than 150 products in order to fix the real values.

5.4.2.b System Configuration and Tailoring

As mentioned previously, the process modelling activity defines the system configuration and tailoring requirements. The ES was configured to follow the modelled processes. For instance, in order to support the sales cycle, the system was configured to reflect the company credit and accounts receivable policies. The same took action for the procurement's policies previously defined. The ES was also tailored in many ways. Examples of tailoring out of remodelling the sales and procurement cycles are as follows:

1. *Programming an application for the register of the clients' purchase license*: For many years the company was handling all the information related to clients' purchase licenses through manual systems. The growth of the number of clients and the emergence of new regulations brought complexity to manage it efficiently. As a consequence, the company had already planned to develop an application using the ES provider's language in order to register this information. With this information inside the system, other developments could be programmed for allowing the sales functionality to match automatically the CSO vs. the license.

2. *Developing a special reporting option for matching the monthly sales' profit vs. the planned profit*: a new reporting option was developed for allowing the administration staff to match monthly the sales' profit vs. the planned profit.

This was a similar way of checking the price of each CSO vs. the pricing list; but it does not hinder the speed of the day-to-day operations.

3. *Developing an application for sorting the CSO according to the credit policy*: an application was developed in the product's language in order to sort the CSO according to their accounts receivable status. Those CSO with outstanding accounts were blocked, in order that they would be reviewed by the accounts receivable staff (see the next point). Those CSO without troubles go through unchecked.
4. *Developing a special data output for matching and marking the CSO vs. the credit policy*: those CSO blocked in the sorting procedure are reviewed by the accounts receivable staff to bargain a payment compromise from the client and/or the sales representative. To do this, the ES specialists developed a special data output, which allows the staff to mark those CSO that could be delivered after the bargaining.
5. *Fitting the Outbound Output:* The ES specialists tailored the standard outbound output embedded in the system to match some special key users requirements. For example, fields were added to the output to reflect two sorts of measurements: weight measurements (e.g. kilograms and tons) and volume measurements (e.g. litres).
6. *Developing a special data output for sorting the CSO according to the delivery routes*: Given that the ES did not have functionality for planning delivery routes, the ES specialists developed a data output, which sorted the CSO according to delivery route already defined. Then, the delivery staff could easily match transport vehicles and routes vs. CSO.

7. *Developing further reporting options and data outputs for financial and sales areas:* more than twenty new reports were developed to meet the financial and sales requirements.

Key users acquired the skills and knowledge necessary to configure the ES. However, they relied on ES specialists for tailoring the system. Here consultants acted as ES specialists. In fact, given that the company had an ES outsourcing agreement, key users focused on modelling and configuring activities instead of learning tailoring issues. Because of this CPC was acquiring partially the knowledge required to configure and tailor the system (**learning cycle No. 2**).

5.4.2.c End-user Training

As a result of **learning cycle No. 3**, CPC learnt over time that end-users must be trained firstly in understanding "the forest before the trees", as it was pointed out by a key user. That is, key users would explain the reasons to implement an ES, the alignment between the business objectives and the ES capabilities, the ES integration philosophy and the logic of the processes modelled before giving hands-on sessions related to specific functional areas. Other interesting learning applied by CPC was that of keeping a set of key users supporting end users after the system went live. That is, the auditing team mentioned above was supporting end users in the new way of doing the day-to-day operations over two weeks. As troubles came into view new training was planned and realized (**training learning loop**).

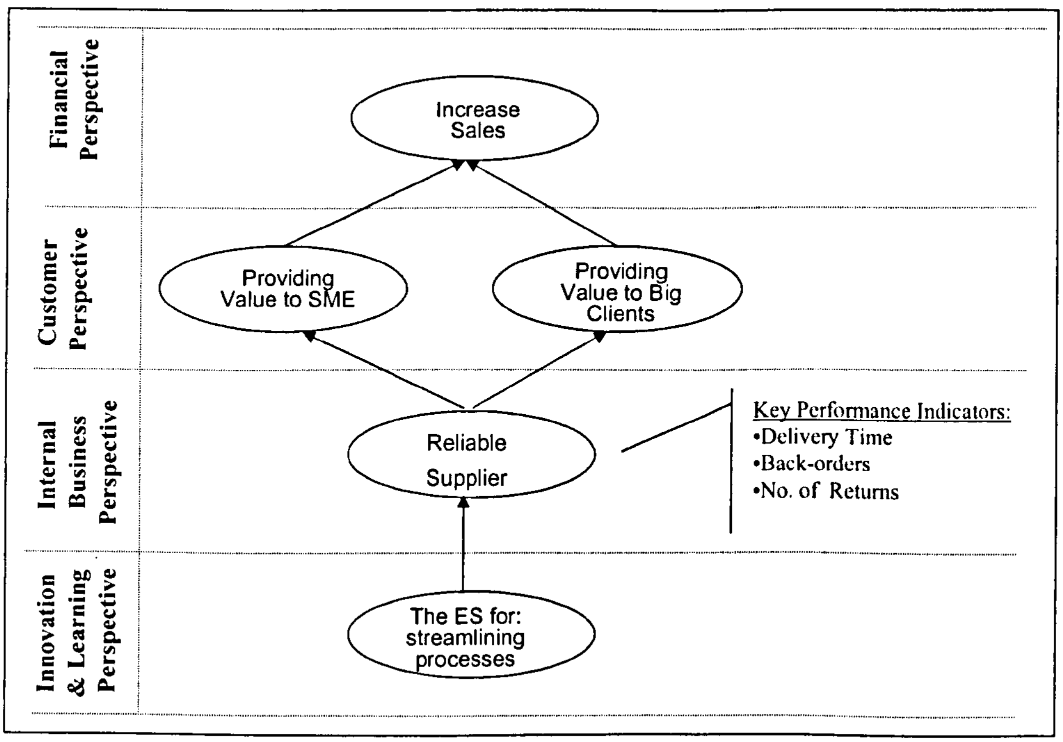
5.4.2.d ES-Use

While CPC was iterating the **learning loops** from the ES-use activity, it was closing the gap between the system and the business needs. As a consequence users were increasingly using the system as a normal activity. As with the other two sites, the CPC's users pointed out that informal networks were activated amongst all users in order to solve troubles and share "tricks". Then **learning cycle No. 4** worked here.

Once the company was completing its first objective (that of optimising the processes already modelled), the aim was to spread the system out to the rest of companies' activities and business units. Hence, the rollout activity would be set in motion since the second half of 2002. First the rollout of the sales functionality into the six remote warehouses and sales centres was planned. Secondly, the functionality of sales and financial accounting would be implemented in the subsidiary placed in the neighbour country. It is worth noting here that some key users who worked in previous implementation were given the responsibility of realizing these objectives. Then the company would begin activating **learning cycle No. 5**.

Finally, the company was planning simultaneously the implementation of new functionality. The functionality chosen was quotation (as part of the sales functionality), enterprise information, DRP, and some financial localizations (e.g. that of value added tax). According to key users, the implementation of the quotation functionality would allow the company to design a more integrated business model between the quotation processing and the CSO processing. For instance, a quotation previously entered in the system could be transformed automatically into a CSO. With reference to the enterprise information functionality, the CEO pointed out: "once we complete the automation of the primary processes, we have to move quickly to support the decision making process; ...until now we had done nothing about it and this is vital for the company." In fact, CPC had already defined its own information needs. This was represented using the balanced score card approach (see Figure 5.9). This approach would be matched against the ES functionality. According to consultants "the ES could satisfy very well this need through its tools for representing objectives, monitoring progress toward goals, and monitoring the performance of key indicators". Then, CPC had begun a further iteration of the cycle of process modelling and organizational adaptation, system configuration and tailoring, and end-user training.

Figure 5.9 The CPC's Enterprise Information Model:
An example of Business Objectives and Key Performance Indicators



5.4.3 Summary of Activities

Table 5.4 shows the most relevant events related to the activities and cycles of the diffusion process in CPC over time. After nearly seven years, CPC had partially completed the implementation of its ES in support of the company's functions and business units. Up to 2002, the ES implementation had encompassed the adoption of the functionality of financial accounting, distribution and sales, and materials management; and the rollout of functionality of financial accounting and distribution and sales into the six regional offices (see enhancement cycle in Table 5.4).

By looking at Table 5.4 one can see that the enhancement cycle was stopped over four years (between 1998 and 2001). No functionality was selected to be implemented neither was rollout realized. On the other hand, between 1998 and 2000, business adjustments and system changes were scarce. These were reduced to developing reporting options in a third party provider. (see business adaptation loop and system configuration and tailoring loop in Table 5.4). Since 2001 a huge effort of adaptation began in order to identify and correct mismatches between the functionality already implemented and the business processes. Finally, the diffusion process throughout the company was launched again in 2002 (see enhancement cycle in Table 5.4).

In CPC the diffusion process can be described as the sum of discrete episodes of implementation of functionality and mutual adaptations between the business and the system.

Table 5.4 The ES Diffusion Process in CPC: Events by Chronological Time Periods and Activities-Loops

		1996 - 1997	1998 - 2000	2001 (1st half)
Enhancement Cycle	Selection of new functionality for implementation	The functionality related to the sales cycle and the procurement cycle. (i.e. financial accounting, distribution and sales, and materials management)		
	Rollout of functionality already implemented			
Process Modelling & Org. Adaptation	As part of the sequence of activities	Modelling the sales cycle & the procurement cycle		
	As part of the feedback loop			Remodelling the distribution and sales process. This originated a huge organizational adaptation: changes in roles, policies, procedures and layout. Remodelling the process of costing and pricing Remodelling the register & control of inventories in order for aligning with the costing model. (e.g. no negative inventories). Modelling the way to register daily the movements and sales in regional warehouses, and transfers from the plant into the regional warehouses, whilst rollout into remote warehouses is completed
System Configuration & Tailoring	As part of the sequence of activities	Configuring the functionality of financial accounting, distribution & sales, and materials management		
	As part of the feedback loop		Developing reports in Excel for the sales area Developing an application for connecting the remote warehouses to the plant. (Cancelled when roll out was considered an option in 2002).	Reconfiguring the accounts plan and the financial statements Creating a form for the processing of cheques.
End-user training	As part of the sequence of activities	Operational Training of functionality of FA, MM, and D&S for end-users		
	As part of the feedback loop		Operational training of the functionality of FA, MM, and D&S for new end-users and users with many doubts	

Table 5.4–continued. The ES Diffusion Process in CPC: Events by Chronological Time Periods and Activities-Loops

		2001 (2nd half)	2002 (1st half)	2002 (2nd half)
Enhancement Cycle	Selection of new functionality for implementation		The enterprise information system (EIS) functionality (BSC was created).	Plan: 1) Implementing the DRP functionality; 2) implementing the quotation functionality (when all sales representatives can access the ES); 3) developing an application for controlling regulations related to chemical products with an interface to the ES
	Rollout of functionality already implemented		The financial accounting and distribution-sales functionality into the six regional D&S centres.	Plan: Rollout into the subsidiary located in the neighbour country
Process Modelling & Org. Adaptation	As part of the sequence of activities			
	As part of the feedback loop	Remodelling the procurement process for all types of goods. This resulted in huge organizational adaptation: changes in roles, policies & procedures. Use of an auditing team in order to control deviations & suggest new improvements into the D&S process. Several loops occurred – after using the new process – for redefining roles or procedures. (e.g. assigning the register of returns into the sales staff).	Remodelling the treasury process. Modelling the key performance indicators (creating a Balanced Score Card)	Plan: Modelling the DRP functionality Modelling the quotation process
System Configuration & Tailoring	As part of the sequence of activities	As a result of the business adaptation loop, reconfiguring and tailoring the functionality of FA & D&S according with changes suggested in the new modelled process (e.g. completing clients master data, setting parameters, programming new data outputs,) Reconfiguring & tailoring the functionality of FA and MM in order to follow the new model of costing and pricing; and reconfiguring the MM and D&S functionality in order to follow the new model of inventory	Reconfiguring & tailoring the functionality of FI & MM in order to follow the new modelled procurement process (e.g. completing master data, setting parameters, programming new data outputs, operationalizing business policies, and adding fields to screens)	Plan: Configuring and tailoring the functionality of Executive Information System, Treasury, Quotation, and DRP.
	As part of the feedback loop			
End-user training	As part of the sequence of activities	As a result of the business adaptation loop: 1) conceptual training of the new business processes and ES integration philosophy; 2) operational training of new procedures, policies, and roles	As a result of the business adaptation loop: 1) conceptual training of the new business processes and ES integration philosophy; 2) operational training of new procedures, policies & roles.	Plan: Conceptual and operational training of new processes and functionality implemented
	As part of the feedback loop	As a result of the auditing process, retraining related to new procedures & policies Educating to clients in new sales procedures Training in accounting because functional deficiencies were discovered.		

5.5 Discussion

This chapter gives a detailed examination of the ES diffusion inside organizations. As such, the chapter represents an initial attempt to examine ES implementation from a *technological diffusion perspective*. The chapter is based upon multiple-case sampling. One aim of studying multiple cases is to notice events and processes across many cases (Miles & Huberman 1994). By using this strategy one can consider that the emerging diffusion model is generic, in the sense that the model has been seen working out in a predictable way on the basis of matches from a case to the next, not to a larger universe. This has been done preserving the individual uniqueness of each case. Hence, the strategy has allowed the researcher to avoid superficiality and to keep the richness of each case. On the other hand, by attempting to connect the grounded theory with existing formal theory, a general theoretical discourse has been developed.

5.5.1 The Distinctive Features of ES Internal Diffusion

The three cases under study tell of the vast scale, long duration and tremendous detail that can be involved in ES implementation. As seen in this study, an ES project can touch most of the functional divisions of an organization. Moreover, in all sites under study the ES experience spanned at least six years and addressed hundreds, perhaps thousands, of specific activities carried out by each organization. It can be seen that with the progress of each project, the companies were themselves being significantly remade.

Within the model, the experience of using the ES is shown at the heart of the diffusion process. It feeds into business adaptation, system configuration and tailoring, and enhancement activities. The users' experience is, in turn, fed by all of these activities. Knowledge and insights accumulated from different aspects of the diffusion process are pulled together and disseminated in the training activities. From the experience of using the system appears the two *distinctive features* of the ES diffusion process: the **enhancement cycle** and the **loops** related to business adaptation and system configuration and tailoring.

First, the implementation of ES functionality follows a virtuous **enhancement cycle** in which each round represents:

a) The adoption of new functionality, in which the development of new knowledge results from the turbulent experiences of first time attempts and pilot applications; or

b) The rollout of functionality already implemented into new business units or facilities, which is guided by the more confident insights lessons.

Hence, a positive feedback in the **enhancement cycle** motivates the full incorporation of an ES throughout the company. Second, from the experience of using the ES and in response to a) mismatches found between the modelled and actual processes, b) better understanding of ES and its true ramifications, and c) new organizational needs, the **business adaptation loop** and the **system configuration and tailoring loop** are activated. Both loops refer to adjustments and change in the ES and the organization following installation the system. These adaptive efforts increase the satisfaction with the ES. To ease the identification of these two **loops** in subsequent discussion, this study will use the term "technological adaptation" introduced by Tyre & Orlikowski (1994) – see section 5.5.3.

In sum, the ES diffusion model can be characterized by answering two key questions from the innovation literature: how does an innovation (The ES) spread in a population? (Kimberly 1981); and how does the "technological adaptation" (between the ES and the organization) occur? (Tyre & Orlikowski 1994; Leonard-Barton 1988). The former is answered by looking at the **enhancement cycle**. The latter is found in the **loops** related to the business adaptation and system configuration and tailoring.

Finally, the different dimensions of (a) process modelling and organizational adaptation and (b) system configuration and tailoring can be considered as representing the authentic signature of the ES implementation experience. These fulfill Markus and Tanis's (2000) and Brehm's (2000) observations, which ES projects live with different tensions across business process redesign, configuration and coding. In the three cases, it can be seen how these two dimensions cause different kinds of obstacle in the diffusion voyage. Coding is the most difficult challenge: the task of the implementation team is to remain in the relative comfort zones of configuration and business adaptation as much as possible. This strategy (i.e. coding as a last resort) replicates the findings of other ES case studies (e.g. Kawalek and Wood-Harper 2002).

5.5.2 The Learning Challenges Required By ES Diffusion

Essentially, the three experiences were Lewinian in character, supporting the formation of concepts and generalizations, their testing in different situations (e.g. the left hand side of Figure 5.1), their contribution to concrete experience (e.g. the right hand side of Figure 5.1) and feedback and reflections from there. The character of the ES adoption task seems to be to learn about a pre-existing model and all of its implications, and from there, to learn about where and how the model must be refined.

The **learning cycles** give the detail of what is learned through the course of the diffusion process. They provide plentiful evidence of the different kinds of learning challenge culled from the literature and presented above. Rosemann's (2001) identification of the need to gather the know-how of process modelling is clearly exemplified through **learning cycle No. 1**. Here, key users and consultants in all sites gathered the know-how of process modelling and applied it to organizational design tasks. In fact, in one of the cases under study (ESC) the learning cycle No. 1 originated a customized modelling methodology for the company (see section 5.3.2). Soh's (2000) identification of the need to learn about the complex functionality of the ES is recorded throughout, particularly **learning cycle No. 2** and **No. 3**. Markus's (2000) suggestion that the concept of cross-functional integration presents a particular learning challenge is clearly illustrated by the problems all three companies found with mismatches between the modelled processes and actual processes (e.g. requisition for material process in CC; the time recording process in ESC; or the sales cycle in CPC). Table 5.5 shows the learning challenges for each activity in the diffusion process.

This experiential learning is a key leverage for the diffusion process as characterized in section 5.5.1. As Tyre and Orlikowski (1994) point out, "it is only through experience with a new technology that users discover its ramifications" (p. 99). And it is from these discoveries that users activate continuous adaptive efforts (e.g. business adaptation loop and system configuration and tailoring loop) in order to maximize the effectiveness of new technologies.

Table 5.5 The Learning Challenges related to each activity of the ES Internal Diffusion

	Learning Challenges	
Activities	**Know-How**	**Know-Why**
Process Modelling & Org. Adaptation (Learning Cycle No. 1)	Acquisition of the ability to model business processes (methodology, languages, tools)	Acquisition of the ability to articulate a clear understanding of organizational needs, ES business practices, and ES integration philosophy.
System Configuration & Tailoring (Learning Cycle No. 2)	Acquisition of the ability to configure and tailor the system	
End-user Training (Learning Cycle No. 3)	Developing training and coaching skills	
ES-Use (Learning Cycle No. 4)	Acquisition of the ability to operate the system.	Increase of the conceptual understanding of organizational needs, ES business practices, and ES integration philosophy. Possible matches and mismatches activate feedback loops.
Rollout (Learning Cycle No. 5)	Acquisition of the ability to carry out rollout (methodological issues)	

This way of viewing the learning challenges related to ES diffusion contrasts to that of viewing the ES experience as knowledge transfer process (Coulliard *et. al.* 1999; Volkoff and Sawyer 2001). While the experiential learning highlights the need for learning and skill formation *in situ* (Attewell 1992), knowledge transfer emphasizes on the movements of knowledge from the consultants to the users (Attewell 1992; Coulliard *et. al.* 1999). This study shows the importance of knowledge creation by users in response to the ES difficulty and the deficiency of knowledge transfer from the ES consultants.

In addition to these key-learning challenges, all of the sites under study give another managerial challenge. It is to learn about the process of learning and dissemination itself. This knowledge management issue should not be surprising, given the long, broad and detailed impacts of the ES. It is vital that the organization is able to teach itself what it knows. Key users had a fundamental role in the dissemination process. Yet, these key users had themselves to learn about the task of coaching and aiding other users. Moreover, the effectiveness of the learning operation was threatened in two cases (CC and CPC), when high turnover of personnel meant that consultants played the coaching role, rather than key users. All companies needed to learn about learning as an organization, and it needed the individuals who were confident and eager for this task.

In sum, one can consider that the ES diffusion will be successfully realized when companies manage it as an exercise in innovation (Leonard-Barton 1995), in which a learning-oriented strategy produces a self-sustaining diffusion. In the three organizations under study "learning has transformed the impulses, feelings, and desires of concrete experience into higher-order purposeful action" (Dewey in Kolb 1984; p. 22), which has been the key leverage for the ES diffusion process.

5.5.3 The Timing of ES Diffusion: Continuous and Discontinuous Patterns

Although the three cases pursue the diffusion model described in Figure 5.1, their experiences differ significantly in the timing of the diffusion process. The CC's diffusion process can be characterized as a continuous process of a) spreading the system throughout the company and b) technological adaptation between the ES and the organization. As can see in Table 5.1, each year of its six-year diffusion process CC activated the enhancement cycle. Every year, CC either selected new functionality for implementation or (and) rolled out functionality already implemented. In addition, the loops related to business adaptation and/or system configuration and tailoring were continually carried out every year after the first functionality was installed. This can be verified by looking at in the boxes in Table 5.1 related to these loops and each year after 1998. There are events located in such boxes.

However the other two cases followed different patterns. As can see in Table 5.2, the enhancement cycle in ESC was stopped over a year (1999). However, the loops related to business adaptation and/or system configuration and tailoring kept continually working after the first functionality was installed (i.e. between 1998 and 2002). Finally, as can see in Table 5.3, the enhancement cycle in CPC was stopped over four years (between 1998 and 2001); and the loops related to the business adaptation and/or system configuration and tailoring were off over three years after the first functionality was installed (i.e. between 1998 and 2000). This can be verified by the reader by looking at the corresponding boxes in Table 5.2 and Table 5.3, respectively.

To characterize these different experiences this study takes concepts from the innovation literature. By tying the emergent theory to existing literature this study aims to enhance the internal validity, generalizability, and theoretical level of theory building from case study research (Eisenhardt 1989). A useful classification for technological adaptation in the literature is that explained by Tyre and Orlikowski (1994). According to them, the timing of technological adaptation can be classified as following a continuous pattern over time (the innovation literature view) or following a pattern of discontinuous modifications (the behavioral research view).

With reference to the timing of spreading an innovation throughout a company, little research has been done. The search is more difficult still when one attempts to find examples of innovations with the modular characteristic of ES, which implies implementing different features each time, instead of the same feature in different locations (e.g. an spreadsheet application). However, some works (Kimberly 1981; Rogers 1995) seem to suggest that the widespread use of an innovation inside organizations might progress following a similar pattern of that of technological adaptation explained by Tyre and Orlikowski. Then, one could identify a pattern of continuous spreading and another of discontinuous spreading.

Using these concepts of continuous and discontinuous patterns and the two *distinctive features* of the ES diffusion process described above (section 5.5.1), one can characterize the CC, ESC and CPC's experiences. The two dimensions (the timing vs. the distinctive features of ES diffusion) yield a classification matrix of four quadrants (Figure 5.10). They are:

1. Continuous Spreading throughout the company (i.e. doing continually the **enhancement cycle**).
2. Discontinuous Spreading throughout the company (i.e. doing intermittently the **enhancement cycle**).
3. Continuous Technological Adaptation (i.e. doing continually the **loops** related to business adaptation and/or system configuration and tailoring).
4. Discontinuous Technological Adaptation (i.e. doing intermittently the **loops** related to business adaptation and/or system configuration and tailoring).

Within CC, one can find a company that developed a continuous approach for both the **enhancement cycle** and **loops** related to the business adaptation and system configuration and tailoring. Then, the CC experience is placed in quadrants 1 and 3. Within ESC, there is a company that held a continuous approach for the technological adaptation activities, but a discontinuous pattern for the **enhancement cycle**. Then, the ESC experience is placed in quadrants 2 and 3. Finally, CPC followed the discontinuous pattern for both distinctive features. Its experience is located in quadrants 2 and 4.

Figure 5.10 The Timing of the Two Distinctive Features of ES Diffusion

		Temporal Pattern	
		Continuous Improvement	**Discontinuous Process**
The Distinctive Features of ES Diffusion	**The Enhancement Cycle**	**1** *Continuous Spreading throughout the company* (CC)	**2** *Discontinuous Spreading* (ESC, CPC)
	The Loops (Technological Adaptation)	**3** *Continuous Technological Adaptation* (CC, ESC)	**4** *Discontinuous Technological Adaptation* (CPC)

Such a classification can be used – either ex ante or ex post – to explain, anticipate or evaluate the diffusion process of an ES throughout an organization. Given that higher levels of use of the ES (infusion) is dependent on higher levels of diffusion, a continuous pattern of diffusion will allow organizations to achieve higher levels of use sooner rather than later. That is, a continuous pattern is likely to allow organizations to exploit the full potential of ES faster, which can imply to achieve a competitive advantage by faster assimilation of ES capabilities. This is particularly critical in competitive dynamics in which everybody has implemented an ES and become more difficult to differentiate the benefits of an ES from a company to another – e.g. oil, chemicals, and consumer products (Davenport

2000). Then, the important issue is no longer just having an ES, but rather implementing it better than anyone else. For Davenport, "one company can achieve advantage by implementing its ES faster, cheaper, or more effectively than other." (2000; p. 110). Furthermore, and for either type of industry, if a company diffuses an ES earlier than others, the company has a chance to be the first to change the business that benefit customers and partners, the company has a chance to learn to use it effectively before competitors, the company has a chance to be the first to implement new customer-oriented or supplier-oriented modules that bring further advantage (Davenport 2000).

On the other hand, and considering the views of Kimberly (1981), Attewell (1992) and Cohen & Levinthal (1990), the speed at which an innovation is (or is going to be) diffused may affect organizational decisions related to

1) the design of effective internal promotional strategies (communication as central in the diffusion process – Rogers & Shoemaker 1971), and
2) the development of novel mechanisms for lowering knowledge and technical barriers to diffusion (e.g. consultants vs. in-house support – Attewell 1992 - and/or increasing absorptive capacity by, for example, purchasing expertise from outside sources – Cohen & Levinthal 1990)

CHAPTER 6: A MODEL OF ENTERPRISE SYSTEMS INFUSION

Chapter 5 dealt with the diffusion stage as part of a technological innovation perspective of the ES implementation. The diffusion stage identified activities, beyond the typical ES implementation such as technological adaptation and enhancement cycles, which lead to more widespread use of the ES inside organizations. This chapter completes the development of a technological innovation perspective for the ES by adding the concept of infusion. Infusion occurs when 1) an innovation become incorporated within the organization's routine in a way that 2) it is used to its full potential in order to 3) increase business performance (Rogers 1995; Cooper & Zmud 1990; Kwon & Zmud 1987; Sullivan 1985). Infusion is also known in the literature as routinization or incorporation (Rogers 1995; Kwon and Zmud 1987). According to Rogers (1995), when the infusion stage[16] is finished, the innovation process in an organization is complete. While diffusion relates to widespread use of the ES inside an organization, infusion is concerned with the extent and quality of this use – i.e. how much the ES (after its diffusion) has been incorporated within the organization's routine and whether the business performance has been increased.

This chapter attempts to develop a model of ES capabilities and apply this model to analyse how ES were infused in the three sites under study. The structure of the chapter is as follows. First, the model of ES capabilities and how to analyse the ES infusion are described. The subsequent sections present the evidence from the three sites that support the framework developed. Finally, a discussion of the ES infusion and its relationship with the diffusion stage occurs.

---

[16] Rogers identifies the infusion stage as routinizing.

6.1 ES Capabilities: The ES potential and its impact upon the business

ES potential has been reported by a number of authors (Davenport 1998 and 2000; Markus and Tanis 2000). A set of examples can be identified from automation of business transactions, interdepartmental coordination, to more sophisticated uses such as applying operations research techniques into processes management (e.g. MRP). Although much evidence has been reported around these issues, it is scattered without connection. Then, there is a need of a framework that allows viewing all the ES potential in a single map. This section tackles this need by developing the ES capabilities model, which represents taxonomy of ES uses in an organizational context.

The model itself was initially formulated from concepts in IS and ES literature (Zuboff 1988; Hirschhorn and Farduhar 1985; Doll and Torkzadeh 1998; Davenport 1998 and 2000) and from the pilot study in this investigation. Later the model was re-applied, validated and tuned through the three subsequent case studies. The following lines describe how the author derived the model. The study of the pilot case identified that there was a concern about the low level of use of the ES after installation. Interviewees considered that the ES was used only as a transactional tool, but neither as a means to support the decision-making process nor to support better coordination between different business areas. From this concern, the author investigated models of classification of IT uses from the IS literature. First, by applying the Zuboff's (1988) IT roles, the author began dividing the possible ES uses in twofold: automating and informating. Later, by applying the Hirschhorn and Farduhar's (1985) and Doll and Torkzadeh's (1998) classifications, the author subdivided the possible ES informating role in threefold: decision-making support, work integration, and customer service. Hence, automating was defined as applying ES to automate business processes so that these processes can be performed with more continuity, uniformity and control; and informating was defined as using ES to generate information about the processes so that organizations can improve their decision-making processes (decision support), coordination between different business areas (work integration), and customer service to internal and external clients.

This initial scheme was re-applied, validated and tuned through the three subsequent case studies. Users from all sites under study were asked to comment on the different areas of functionality within the initial framework, whether they were using these ES capabilities, whether they were part of normal activity, and whether they had evidence of increased organizational effectiveness and business performance. This exercise allowed the author to have more clarification of the ES capabilities. As a result, some reconsideration on the early framework was done. Two further capabilities were identified: monitoring performance and process management automation. Linking these two additional capabilities to the ES literature allowed the author to validate them with one of the Davenport's (2000) works.

By iterating and linking findings with literature, this study has developed a model of six general ES capabilities. The capabilities that can be used and exploited by an organization are as follows: 1) transaction automation, 2) decision-making process support, 3) monitoring performance, 4) customer service, 5) coordination, and 6) process management automation. As a multidimensional framework, this model has advantages in recognizing the organizational functions for which an ES is utilized, which originates better characterization of the extent of use (Doll and Torkzadeh 1998). The ES capabilities are explained in turn below.

6.1.1 Transaction Automation

This capability can be defined as utilising ES to automate business transactions in order to perform them with more uniformity and control (Zuboff 1989; Davenport 2000). Such capability includes processing data in an integrated and standardized manner, standardized flow of work, transaction control through business rules, and the possibility of tracking transactions and data. ES literature (Sasovova *et. al.* 2001; Markus *et. al.* 2000; Westerman and Cotteleer 1999; Davenport 1998; Worthen 2002; Benchmarking Partners 1997b) shows a number of cases where transaction automation is one of the first benefits of ES implementation:

a) Standardizing transactions by using ES made Union Carbide more efficient (Davenport 1998).

b) Dow Chemical achieved more consistent operating practices across their geographically dispersed units by using ES (Davenport 1998).

c) Under the premise of "One Nestle under SAP", Nestle transformed the separate brands into one integrated company. For example, the project team implemented a common data structure across the company – e.g. 'vanilla' was coded as 1234 in every division (Worthen 2002).

d) The implementation of an ES allowed Tektronix to handle a worldwide chart of accounts and a single item-master table (Westerman and Cotteleer 1999).

e) Monsanto achieved an exceptional degree of "commonality" across a diverse set of global businesses. For instance, by using ES the company reduced the coding scheme for suppliers from twenty-four to just one (Davenport 1998).

f) ES provided Hoechst Marion Roussel better control of its finish-goods inventory and allow it to save transportation costs. The company can now know when the order was placed, when it was packed, how it was shipped, and when it arrived (Benchmarking Partners 1997b).

g) Owens Corning can track daily finished-goods inventory both in warehouses and the distribution channels (Davenport 1998).

6.1.2 Decision-Making Process Support

This capability is concerned with business decision-making based on data provided by ES. Many authors have reported that the standard ES functionality is deficient in fulfilling this organizational need (Brehm *et. al.* 2000; Markus *et. al.* 2000, Davenport 2000). Although ES are typically transaction processing systems, they may be augmented during further development of the ES (Bashein and Markus 2000; Brehm *et. al.* 2000). In fact, a common ES tailoring type realized by companies is programming extended data outputs and reporting options (see Brehm *et. al.* 2000)[17]. For instance, Microsoft Corp developed custom reports using the ES data, and delivered by using the intranet (Bashein *et. al.* 1997). In addition to these examples, ES vendors have recently developed enhanced functionality that provides decision-support tools such as query, reporting, statistical analysis capabilities, and multidimensional analysis (Davenport 2000; SAP 2002).

[17] Chapter 5 describes a number of examples related to the development of report options to meet the organizational needs across the three sites under study.

6.1.3 Monitoring Performance

This capability is concerned with the recording and monitoring of performance indicators. Typically this is achieved through management information tools, which give direct access to key performance measures of a company. For instance, the Baan IV product allows users to see an overview of the overall business performance by using Ishikawa fishbone diagrams (Jendry 2000). Managers can 'drill down' to the indicators and bring information from an integrated data repository. A set of predefined performance indicators is available, with the additional capability of developing custom indicators. SAP suite (SAP 2002) also offers tools to help managers to visually represent objectives, to monitor progress toward goals, and to monitor the performance of key indicators. Furthermore, in the near future ES providers will be able to link their current performance systems with common management framework such as Balanced Scorecard (Davenport 2000).

6.1.4 Coordination

This capability is a perennial topic in studies of the organizational impact of information technology (Crowston 2001; Malone and Crowston 1994; Rockart and Short 1989; Abarca and González 2000; Hirschhorn and Farduhar 1985). This framework relies upon Malone and Crowston's (1994) definition of coordination as "managing dependencies". That is, coordination is seen as a response to troubles caused by dependencies. Typical dependencies that may be handled by ES are those defined by Crowston (2001) as "share resource" and "producer-consumer". In the ES context, *share resource* can be seen as sharing the same body of information between different departments or business units that require it simultaneously. *Producer-consumer* is concerned with synchronizing activities or processes embedded in a value chain so that the resource required by the consumer is available when needed.

The ES coordination capability can be seen clearly in the Elf Atochen case (Benchmarking Partners 1997a; Davenport 1998). For instance, when *sharing* information, the sales forecast and production plan can be viewed online and simultaneously by everyone in need of this information (e.g. account managers, customer service, and manufacturing). The result of this is that inquiries from Customer Service to Manufacturing about finished products were eliminated. In relation to the *producer-consumer* dependency, the ES allowed the company to link the ordering and production systems. As orders were entered, the system automatically updated forecasts and production plans, which enabled the company to quickly change its production runs in response to customer needs (i.e. synchronizing activities or processes in the internal value-chain). As Diaz (2000) argues, ES involve a conversion of disconnected vertical silos or departments, into horizontally integrated and coordinated cross-functional processes.

6.1.5 Customer Service

This capability is concerned with using ES to provide differentiated and customized service to internal and external clients. This definition has been borrowed from the IS-use framework by Hirschhorn and Farduhar (1985). It relates to the general argument made by Porter and Millar (1985) that information technologies can affect a company's ability to differentiate itself by optimizing its processes to customers' needs. Christopher (1992) argues that an organization reaches differentiation when customers perceive that making a transaction with the company is more "profitable" than with others. For example, an ES may support easier and speedier ordering by customers. This is also the case of Elf Atochem. By linking the ordering and production systems (see coordination above), sales representatives began promising firm delivery dates, which translated into improved service levels. Achieving service advantage through using ES was a very well planned target by Elf Atochem in order to win customer orders (Benchmarking Partners 1997a; Davenport 1998).

6.1.6 Process Management Automation

While transaction automation refers to the processing of transactions in an automated way, process management automation is concerned with the automating of administrative processes. That is, the ability of ES to take action on data by incorporating business rules and the heuristic that business specialists previously used to manage the process manually (Davenport 2000). The sophistication of this capability has evolved over time. Sophisticated algorithms and operations research techniques have been lately embedded inside the ES. In some cases, this has been possible through the development of bolt-on applications by third-party vendors (Davenport 2000). MRP (Materials Requirements Planning) and DRP (Distribution Requirements Planning) are examples of management techniques supported by ES[18]. The most sophisticated ES provide automated supply chain management

[18] MRP/DRP techniques have been developed as sophisticated, computerized planning tools that aim to make the necessary materials or inventory available when needed. The concept originated with materials requirements planning (MRP), an inventory control technique for determining dependent demand for manufacturing supply. Subsequently, manufacturing resource planning (MRP II) was developed with the objective of improving productivity through the detailed planning

(SCM). SAP has recently unveiled the Advanced Planner and Optimizer (APO) as its tool for the Supply Chain Management (see www.sap.com).

A remarkable example of the use of process management automation is described by one of the Stanford's teaching case, which shows the manufacturing process under SAP/R3 (Whang *et. al.* 1995). The case covers the processes from order generation until delivery and it describes how the ES take action on data to manage specific processes. For instance, the output of the MRP functionality drives the manufacturing and purchasing functions. Given that each product to be manufactured has a bill of materials (BOM), which list all components necessary to create a final product, the ES 'calculate' the gross requirements for every component according with the production plan. Whether the current inventory is not enough (i.e. gross requirement minus inventory is a positive number), the system uses an 'optimal lot sizing' (similar to the Economic Order Quantity (EOQ) technique) to determine the quantity to order or produce. For materials produced in house, the MRP functionality creates a planned order, which can be converted into a production order. For purchased parts, the system creates a purchase requisition, which can be converted into a purchase order by the procurement area.

By using the framework of ES capabilities described above, evidence was collected about the effective use of the ES. As mentioned previously, users from all sites under study were asked to comment on the different areas of functionality within this framework, whether they were using the capabilities, whether they were part of normal activity, and whether they had evidence of increased organizational

---

and control of production resources. MRP II is based on an integrated approach to the whole manufacturing process from orders through production planning and control techniques to the purchasing and supply of materials. Distribution Requirements Planning (DRP) is the application of MRP II techniques to the management of inventory and material flow – effective warehousing and transportation support. (Rushton A. *et. al.* 2001).

effectiveness and business performance. Once the extent of use of the ES capabilities was analysed in each site, the levels of ES infusion at a particular moment of the ES experience was projected by considering two dimensions: 1) the number of ES capabilities incorporated and 2) the number of business areas, units or processes that has been affected by each ES capability. As the infusion stage is considered as a process, time is also introduced as further dimension. Each site is explained in turn below.

6.2 ES Capabilities in CC

6.2.1 Transaction automation

The CC case reveals a number of examples of transaction automation. For example, sales transactions were automated, allowing CC to realize a number of benefits. These include the following:

- Processing sales orders following standard flows throughout the regional sales centres.
- Reflecting these orders in real time on other areas (e.g. finance and outbound logistics).
- Controlling order confirmation by checking parameters previously configured in the system (e.g. intermediaries credit policies).
- Tracking the status of any order at a specific time.

The benefits were obvious. As the Chief Financial Officer pointed out:

"The ES has allowed us to standardize our processes. Before implementing the ES each remote regional warehouse and sales office could perform its activities according to the premise of its own manager. Now we do not deliver a sales order if the intermediary has accounts receivable expired of more than 30 days. This control was impossible in the past. Now we can safely sell on credit."

Similar examples occurred in all transactions automated by the ES in the finance, procurement, manufacturing, distribution and information technology areas. It is worth noting the information technology case. By implementing the service functionality the IT department automated the entering and recording of service orders from end-users (e.g. printer requires fix or adding fields to a specific report in the ES). These related to both the ES outsourcing and the CC's IT department. The benefits were pointed out by the IT manager as follows:

"The automation of the entering and recording of service orders allowed us to have a standard communication mean with end-users, which translated into better control and tracking of each transaction; ...each order is sorted by the ES according with a priority and complexity scheme, then each is assigned to a specific technician; ...end-users can view the status of their orders by checking them in the system".

6.2.2 Decision-making process support

Support for decision-making proved to be a complex issue for CC. They held the view that the success of the ES project would depend on it being able to provide them with high quality and prompt information. Yet, they felt that the standard version of its ES was unsatisfactory for reporting information. Hence, they demanded the development of the ES functionality to provide better reports. For example, thirty reporting options were developed to meet the finance department's requirements during the second and third years after installation. When these were accomplished, they then reported the extensive and routine use of the ES for decision-making support.

6.2.3 Monitoring Performance

The original plan of CC was to install and use the full performance monitoring facilities of the ES in years four or five. Before then, they found it useful to develop and utilize some performance monitoring functionality in support of their own balanced scorecard approach. As the IT manager pointed out:

"We would think of implementing the ES's management information tool when all transactional priorities were solved. In the meantime, the organization designed its own balanced score card and monitored its key measures through designing specific reports."

As result of this, use of the monitoring performance capability evolved from a) designing specific reports inside the ES, to b) extracting data from the ES and handling it with Excel, to c) using the ES management information tool. For instance, in 2000 CC developed a report inside the ES in order to monitor the performance of the manufacturing costs (e.g. comparing the costs of planned batch vs. real batch). Either by designing specific report end-users were able to monitor the performance of the IT service providers vs. standard performance measures. In 2002, the IT department programmed a dynamic application using Excel and Visual Basic and interfacing it to the ES for monitoring the weekly company's sales budget. Finally, the company would implement the ES's management information tool at the end of 2002.

An interesting anecdote was told by the CEO about monitoring the weekly company's sales budget. According to him, the first time he used this application he viewed that at midweek one of the regional sales centres was having poor sales performance. By projecting this performance into the end of the week he was able to see that the sales for that centre would be less than the sales already budgeted for that week. Then he rang the manager of that centre to check why it could be happening. The manager's first words were "boss, how do you know it?" According to the CEO, after this application they began managing in real time.

6.2.4 Coordination

A number of coordination issues were addressed by the ES project. For example, there were a number of dependencies between accounting and procurement functions that motivated additional effort to share information. Procurement staff had to call external accounting colleagues, or wait to receive a report from external accounting, to know the status of the CC's accounts payable with its providers. The ES served as a coordination mechanism by allowing users from these areas to share the same information.

A further example of the coordination functionality of the ES comes with the finished-goods warehouse located in the factory. After implementing the ES in all regional warehouses over the country, the finished-goods warehouse was able to receive information on warehouses' inventory levels in real time. This information allowed them to send to these warehouses more accurate and prompt replenishment orders. As a consequence, they eliminated inefficient practices such as accumulating buffer inventory stocks in the regional warehouses – which is commonly used as mechanism to de-couple processes in a supply chain instead of synchronizing (Diaz 2000). Hence, the ES had a dramatic impact on the coordination between regional warehouses and the finished-goods warehouse. In addition, the logistics manager pointed out that by integrating the manufacturing, distribution and warehousing areas they expected to reduce the inventory levels from seven days to three days throughout the company over 2002.

6.2.5 Customer service

A number of customer service initiatives were introduced. Some of the earlier ones related to the use of ES functionality to allow end-users (internal clients) to enter service orders for IT. The value of the ES, beyond processing a transaction (see section 6.2.1), is that it allows supporting easier and speedier ordering by end-users. This obviously increased the internal customer service levels provided by the IT department.

Other functions of the business provide further evidence of how customer service interactions have changed as a result of the ES implementation. One example provides a clear illustration of benefit. Prior to the introduction of the new system, intermediaries needed an average of four-hours (half-day) to acquire and load products onto their trucks in CC's sales transactions. After the process improvements took effect, the intermediaries only needed thirty minutes for the same sales transaction. This meant that they could pick products up twice a week instead of once a week. This reduced the intermediaries' average inventory by half and allowed them to use a vehicle of smaller capacity (reducing the cost of carrying inventory). These customer service improvements were widely appreciated by intermediaries.

In the near future, CC had planned to implement the Business-to-Business (B2B) functionality for the sales process applied to big clients. Big supermarkets and chains would be able to send electronic sales orders to CC. By doing this, clients may order easier and speedier than ever. That would be translated into higher customer service level provided by CC, which is likely to allow the company to differentiate itself from competitors.

6.2.6 Process management automation

Once the ES was implemented in the regional warehouses and the finished-goods warehouse, CC began the use of the DRP technique. DRP is an integral part of the ES's inventory management system. This allows planning the flow of goods between warehouses within one company. The roll-up of dependent demand from local warehouses to a central warehouse is governed by supply constraints and warehouse relationships. Recommended replenishment orders are generated automatically for the fulfilment of demand. These orders are effected after approval and release. The use of this ES capability requires a functional expert user able to understand and apply sophisticated management techniques over the organization.

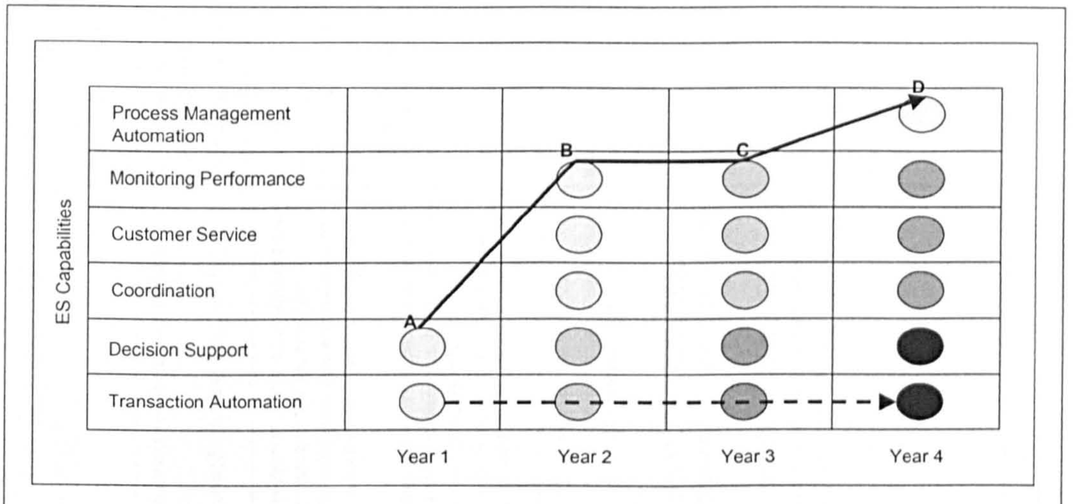
6.3 The ES Infusion in CC

The infusion of the ES in CC was a cumulative process over time. Over four years of ES use the infusion process progressed, with new functionality and capability being adopted (see Table 6.1). In the first year, CC focused on automating transactions and some limited use of reports from the ES. Over the next three years, CC continued automating transactions throughout the organization adding areas and units such as regional warehouses, sales centres, and transport operations. The decision-making process support was extensively deployed in several areas over the same period of time. As a consequence, these two capabilities *penetrated* in a cumulative manner over a period of four years. At the same time as this process progressed, coordination, customer service, and performance monitoring capabilities developed from the second year, and process management automation in the fourth year. Coordination, customer service, and monitoring performance were also incorporated within the organization's routine year by year, in a cumulative manner, adding areas or units each year (see Table 6.1).

The ES infusion process in CC is summarized in Figure 6.1.a. Three dimensions are reflected in it: types of ES capabilities, time, and the evolution of the infusion of each capability. The types of ES capabilities and time are represented by the vertical and horizontal axis, respectively. The circles in cells represent the level of incorporation of each capability within the organization.

Moving horizontally to the right on any row allows the reading of how a specific ES capability was incorporated. Stronger black grades inside the circles from one cell to the next implies that the capability was incorporated in further area or unit in that given year. That is, the cumulative process of infusion for this specific capability (see the dashed line in Figure 6.1.a). The infusion process for the transaction automation capability is also reflected in Figure 6.1.b through a two-dimensional graph. The solid line (Figure 6.1.a) represents the ES capabilities' total infusion process throughout CC. For instance, from the first year to the second year were incorporated three ES capabilities (see the solid line between point A and point B). No incorporation occurred between points B and C.

Figure 6.1.a. The ES Infusion in CC



Dashed Line: The Transaction Automation Capability's Infusion Process
Solid Line: The ES Capabilities' Total Infusion Process

Figure 6.1.b. The Infusion Process of the Transaction Automation in CC

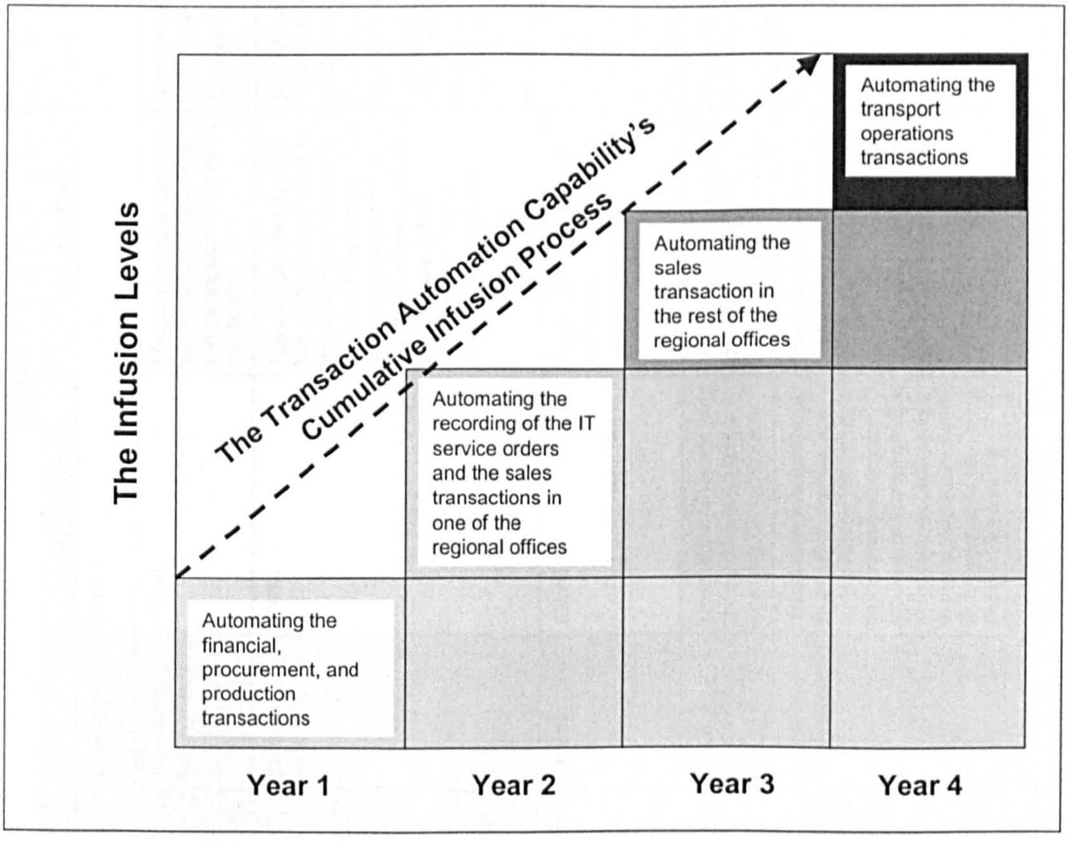


Table 6.1 The ES Impact into the CC's Business by Time & Types of ES Capabilities.

		Year 1 (1999)	Year 2 (2000)	Year 3 (2001)	Year 4 (2002)
ES CAPABILITIES	**Process Mgmt Automation**	CWNI*	CWNI	CWNI	Use of the Distribution Requirements Planning (DRP) technique.
	Monitoring Performance	CWNI	Monitoring performance of the manufacturing costs by comparing planned batch vs. real batch.	Monitoring performance of costs and return on operations in each regional warehouse and sales centres. Monitoring sales performance of intermediaries and final retails' accounts receivables	Monitoring the sales budget using an application in Excel and VB and by bringing data from the ES Monitoring key performance measures using the management information tool functionality
	Customer Service	CWNI	Internal Customer Service: Use of the ES in the factory for entering service orders into the IT department: This automation originated an easier and speedier ordering by end-users, which increased the internal customer service levels.	Internal Customer Service: As a consequence of the integration of the regional sales offices and warehouse centres with the rest of the organization, the close of monthly financial accounts was reduced to three days. This meant an improved customer service for the upper-management and other stakeholders. External Customer Service: Eliminating activities in the sales process to intermediaries, which originated that intermediaries could have more time for selling to final retails, instead of spending time in administrative processes. Best still, by picking products up twice a week instead of once a week, the inventory turnover in intermediaries' trucks augmented.	Internal Customer Service: Use of the ES in regional warehouses and sales centres for entering service orders into the IT department: This automation originated an easier and speedier ordering by end-users. External Customer Service: Providing information to intermediaries about their own sales, accounts receivable, inventories, and effective visits. Receiving electronic sales orders from big clients: This automation would originate an easier and speedier ordering by clients
	Coordination	CWNI	Procurement and external accounting users can share the same information.	The finished goods warehouse can see the regional warehouses' inventory levels. Then, the finished goods warehouse can issue more accurate and prompt replenishment orders. The warehouses' inventory levels decrease from 10 days to 7 days. Procurement centres & the factory can share relevant information.	Coordination between the manufacturing, distribution and warehousing areas that allowed reducing inventory levels from 7 days to 3 days throughout the company (this goal was planned to be reached at the end of the year).
	Decision Making Support	Limited use of reports from the ES. Use of Excel for reporting ES-related data.	Use of the ES for reporting its own data related to finance, IT, manufacturing.	Use of the ES for reporting its own data related to sales and inventories in all warehouses and sales centres. Use of the ES for reporting specific data required by upper-mgmt.	Use of the ES for reporting its own data related to DRP and procurement.
	Transaction Automation	Transaction automation in: financial accounting and administrative processes, procurement in remote facilities and its integration to the factory, processing of production batches and its integration to the financial accounting.	Transaction automation in the following processes: the entering and recording of IT service orders inside the factory, sales processes in one of the twelve regional sales centres.	Use of the ES for transaction automation in the following processes: sales processes in the rest of eleven regional sales centres.	Use of the ES for transaction automation in the processes related to the operation and maintenance of distribution trucks (transport operations), the entering and recording of IT service orders in the remote facilities.
		Year 1 (1999)	**Year 2 (2000)**	**Year 3 (2001)**	**Year 4 (2002)**

*CWNI: Capability was not incorporated on further areas or business units

6.4 ES Capabilities in ESC

6.4.1. Transaction automation

ESC has focused on the automation of financial and payroll transactions. This encompasses the transaction automation of the following business processes: financial accounting, controlling, time recording, payroll, procurement and payment control, financial consolidation, inflation adjustments, and fixed assets. Each automation reflects how uniformity and control have been achieved in one way or another. The following evidence has been reported by users and managers as a sample of the transaction automation's benefits in ESC:

1. The ES has standardized the flow of work in a way that everyone in the company has to follow well-structured norms and procedures. As a consequence, key-users have written procedure and policy manuals in order to support the training and the day-to-day operations.

2. The company has now better control on the timesheets and it is processing this data in an integrated manner so that all business departments have the information quickly available.

3. ESC is processing the financial accounting in a standardized way throughout the business units. This has given better control on the accounting and has eased the financial consolidation.

4. Tracking data is easier than ever. For instance, the accounts receivable's users often track the status of a specific invoice in order to guarantee it is running as usually.

5. Transaction control was being developed on the procurement and payment process in order to display automatic messages to the manager when business rules were transgressed. This would become an on-line control.

6. The company has developed programmes inside the ES to allow the system to validate data entered manually by end-users. This has provided better control in the process of registering employees.

Although the evidence described above is recognized by the company as valuable in the search of the company's objectives, they admit that the benefits of transaction automation have been partially achieved in the company. Only two business areas were automated by ESC over five years: finance and human resources. Worse still, these areas were also developed partially. As the CFO pointed out, "the human resources area is behind; ...they have only automated the payroll, but training and personnel assessment are delayed; ...this fact is not good if one considers that we are a professional services company". With reference to the other areas, the CFO pointed out, "the objective at this time is to use the ES to control the EPC projects; this implies to automate the project and procurement areas." In fact, this was planned to start at the end of 2002 (see selection of the new functionality for implementation in Table 5.2).

6.4.2 Decision-making process support

As with CC, support for decision making proved to be a complex issue for ESC. At the outset, key-users felt that the standard version of its ES was unsatisfactory for reporting information. Hence, some key-users decided to use Excel for reporting ES-related data. But, according to the ES support manager, "the company was extremely inefficient using Excel for taking data from the ES, handling it and creating reports." One of the troubles using Excel was that the company was unable to achieve on-line information. It was a *post-mortem* use of information already happened. As a consequence, they decided to tailor the system to meet their reporting needs. In doing this, key-users used the provider's language to develop specific reports inside the system. The first reports were to meet the finance area. System tailoring was also concerned with doing the standard reports friendlier than their original version. As the ES support manager pointed out, "one of the troubles with the ES is its hostility; ...one can have the data available, but when one is going to extract it, the system is very unfriendly. One has to know the transaction and to know how to enter a set of fields to download the report. This ES characteristic hinders the use of the system by the management. This has been an important deficiency compared to the expected benefits. Managers are not using the system to view data and making decisions. They go to papers."

6.4.3 Monitoring Performance

According to the CFO, both decision-making process support and monitoring performance have been deficient capabilities in the ES implemented at ESC. Three reasons were reported. First, using the system's standard reporting functionality has been insufficient for the company needs. Second, using the provider's language to tailor the system is an expensive alternative because of the lack of specialists in the job market. Third, the use of the management information tool from the ES implied buying new licenses, which would be so expensive, compared to other options. As a result of this, the company decided to acquire a business intelligence

(BI) application from a third-party provider (see section 5.3.5 and selection of new functionality for implementation in Table 5.2). The data exchange between this BI application and the ES was straightforward because an interface had already been developed by the third-party provider. The BI application would be able to support both the decision-making process and monitoring performance through its different functionality: executive information system, decision support system, multidimensional analysis, reporting tools, and data mining. For the CFO, "this application seems to solve the company's troubles related to using information in the upper-management levels; ...in fact, I was disappointed because I promised everyone that the ES would allow us to view the whole company in just one place; ...although this BI solution is not on-line (it works by doing daily refreshment), we are now satisfied."

However, it is worth noting that ESC had been over five years attempting to develop this monitoring performance capability without success (see Table 6.2). As one of the early project managers argued, "we had been many years struggling in order to complete the automation of all company transactions and to achieve more integrated processes; but over four years we had not been able to make decisions using the data from the system. Worse still, we had not been able to develop indicators in the system which tell us if we were going well or wrong in our business."

6.4.4 Coordination

The most evidence related to coordination issues in ESC was associated with sharing the same body of information between different departments or business units that require it simultaneously. Early coordination benefits were located in the financial and human resources areas. Since 1999, these two areas used the coordination capability by sharing relevant information related to payroll transactions. As one of the human resources' key-users pointed out, "the information exchange with finance was evident; all our payroll transactions are used by finance through the ES." The same occurs between the project (in its procurement task) and finance areas. These two areas share information related to accounts payable and payments. Finally, the financial consolidation was more accurate and easier as a result of having financial data from all business units located in the same system.

A "producer-consumer" relationship was also discovered in ESC. Given that the timesheets were processed by the financial area, and then used by the project area, the output of this processing had to be transferred in a timely way to the consumer (see section 5.3.5). The ES allowed the financial area to improve the processing time in a way that the output was available promptly for the project area. In addition, the output was located in the application database (from a temporal database) so that all business units related to (e.g. human resources, finance, billing, and project) could view the same data simultaneously (i.e. share resource).

As can be seen above, the financial area seems to be the only one that is using extensively the coordination capability. As the project area manager pointed out, "given that the ES has not been implemented in the project area yet, coordination between us and the rest of the organization is still poor." In fact, this coordination was being realized inefficiently through much unnecessary work and effort (e.g. data redundancy, waste of time, etc).

6.4.5 Customer service

Four examples were reported by users as evidence of the use of the customer service capability by ESC. First, after implementing the financial consolidation functionality and other functionality related to, the financial area was able to provide more accurate and faster consolidated statements to the Board Meeting and to the Government Regulatory Organisms. Second, as a result of the processing of financial data in an integrated manner and the new standardized financial processes, the auditing area and external auditors were able to audit the financial accounts faster than ever. The annual auditing was reduced from more than three months to less than a month. Hence, the financial area had achieved to optimize its internal processes by using the ES to meet the needs of internal (the Board Meeting and the Auditing Area) and external clients (External Auditors and the Government Organisms).

Third, the human resources area achieved the reduction of mistakes and delivery times related to the payroll process by using the ES. These improvements meant that employees were more satisfied and the organizational climate was perceived as getting better. That is, the human resources area improved the service levels to its internal clients. Finally, by using the ES the project area adapted a part of its procurement and payment process in order to meet the needs of one of its project's partner. The partner company wanted to ease the exchange of information between both companies by standardizing codes and parameters in the two systems. It is important to note that both companies had the same ES, which was an important step in easing the information exchange. This specific ES allowed ESC to differentiate itself from other local engineering companies by using an ES widely used in multinational engineering companies worldwide. The same effect was being expected with the ESC's major customer (The National Petroleum Company[20]). Given that the ESC had acquired the same ES bought by the National Petroleum Company, ESC expected that an easier inter-organizational integration would be possible in areas such as billing, accounts receivable, payments and project. All of these would be translated into higher service levels for its customers.

6.4.6 Process management automation

In ESC the human resources area has been the only one that has used this capability. They have automated the payroll administrative process. As part of the payroll functionality allows the company to take action on the employee data to run the payroll. Business rules are used to manage the process automatically. The payroll process runs an algorithm that calculate the amount to be paid to each employee by considering different parameters such as pay rates, deductions, and taxes. According to the HR Director, the next step in the use of this capability could be to take advantage of the training functionality by identifying the training needs of each employee as a result of the output released by the personnel assessment functionality. For the CFO, the process management automation capability has not been used extensively in ESC. However, he considers that "new opportunities will be learnt over time and utilised appropriately."

---

[20] The name of this company has been disguised

6.5 The ES Infusion in ESC

As with CC, the infusion of the ES in ESC was a cumulative process over time. The use of the ES capabilities progressed over five years (see Table 6.2). In the first year, ESC began with the automation of financial and administrative transactions and with the use of few standard reports from the ES. Over the next four years, ESC continued automating transactions by adding areas and units such as human resources, regional offices, procurement, and financial consolidation. The decision-making process support was deployed over the areas in which transactions had been already automated. Hence, the decision-making process support capability was infusing simultaneously with the transaction automation capability. As a consequence, both capabilities penetrated the organization in a cumulative manner over a period of five years. This dimension is represented in Figure 6.2.a through circles that are filled with a stronger black grade from one cell to next in the capability's row. The dashed line in Figure 6.2.a represents the infusion process of the transaction automation capability. To ease the understanding of this, Figure 6.2.b shows the cumulative infusion process for the transaction automation capability in a two-dimensional graph.

As the same time as the process described above progressed, the coordination capability developed from the second year and the customer service capability from the third year. These two capabilities were also incorporated within the organization's routine year by year, in a cumulative manner, adding areas or units each year (see Table 6.2 and Figure 6.2.a). Although the process management automation capability and the monitoring performance capability were activated over the period of study, they had not penetrated the organization in a cumulative process yet. The process management automation was activated on the human resources area in the third year, but it do not penetrated further areas or units in the subsequent years (see Table 6.2). This is represented in Figure 6.2.a through circles grade similarly from one cell to the next in the respective capability's row. On the other hand, the monitoring performance capability was activated in the fifth year and, as aforementioned, it was extensively deployed throughout the organization in the subsequent years.

Finally, the solid line in Figure 6.2.a represents the ES capabilities' total infusion process. This represents the way as the ES capabilities were incorporated over time. For instance, from the first year to the second year were incorporated the coordination capability and the customer service capability. From the second year to the third year was incorporated just one capability: the process management automation. From the third year to the fourth year no further capabilities were incorporated. From the fourth year to the fifth year, the monitoring performance capability was incorporated (see solid line in Figure 6.2.a).

Figure 6.2.a. The ES Infusion in ESC

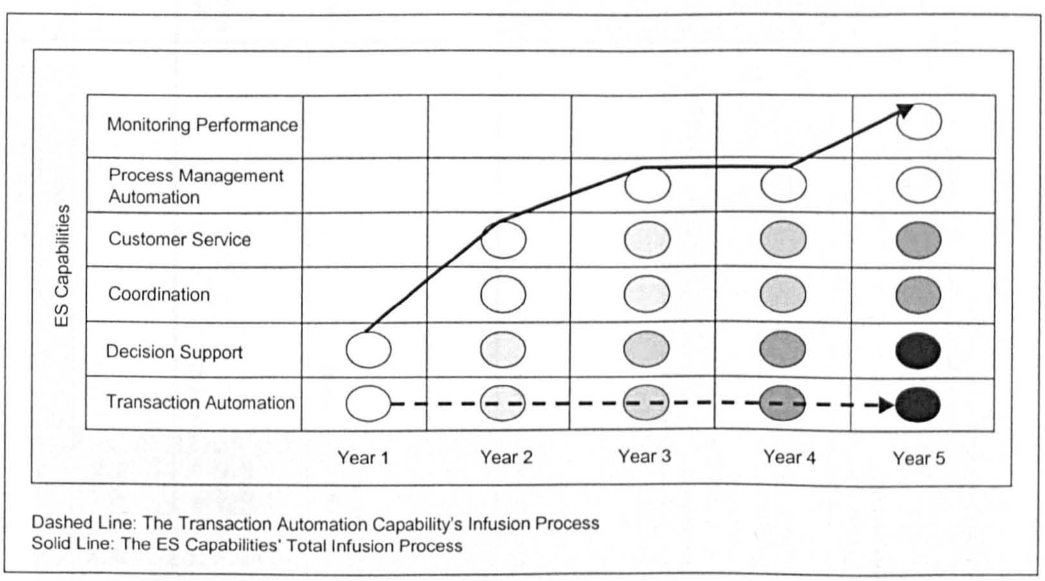
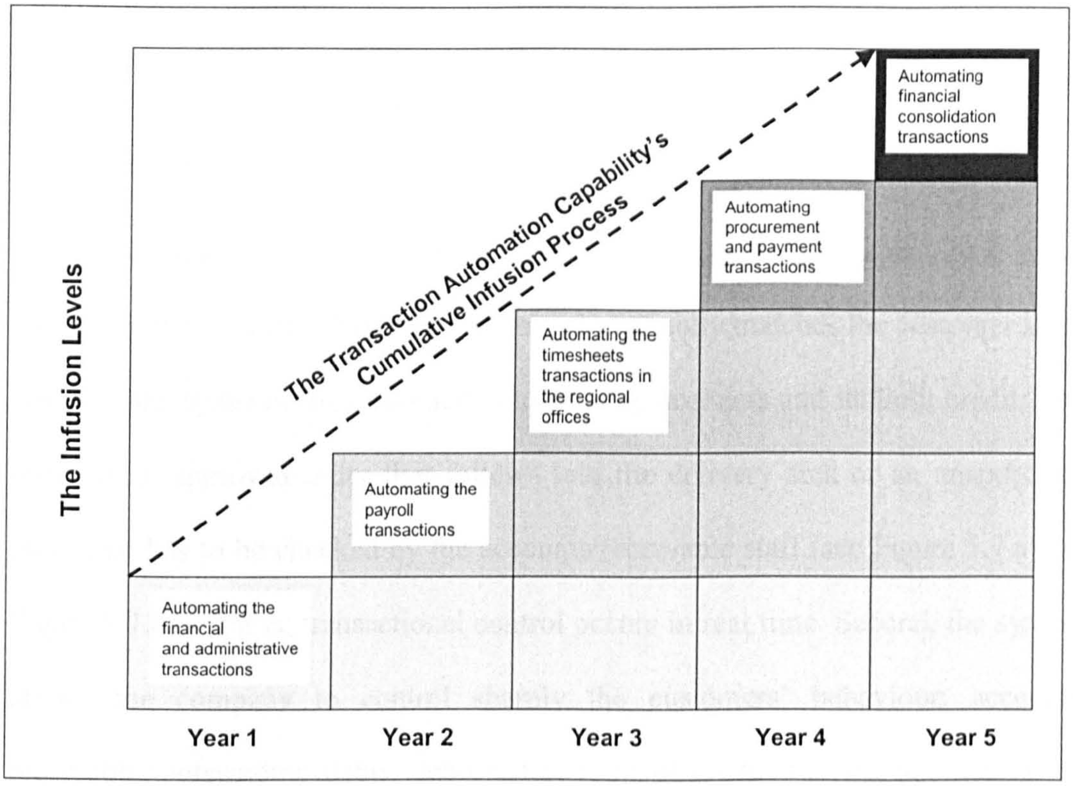


Table 6.2 The ES Impact into the ESC's Business by Time & Types of ES Capabilities.

		Year 1 (1998)	Year 2 (1999)	Year 3 (2000)	Year 4 (2001)	Year 5 (2002)
ES CAPABILITIES	**Monitoring Performance**	CWNI*	CWNI	CWNI	CWNI	Key performance measures using a third-party application and (bringing data from the ES)
	Process Management Automation	CWNI	Capability was not incorporated on further areas or business units.	The payroll functionality allows the company to take action on the employee data to run the payroll. Business rules are used to manage the process automatically	CWNI	CWNI
	Customer Service	CWNI	CWNI	The auditing area and external auditors were able to audit the financial accounts faster than ever The human resources area improved the service levels to employees by reducing mistakes and delivery times related to payroll process	Easier information exchange between the company and those project partners which have the same ES (standardizing codes and parameters)	Providing more accurate and faster "consolidated statements" to the Board Meeting and the Government Regulatory Organisms
	Coordination	CWNI	The finance and human resource areas can share relevant information related to payroll transactions The project, payroll, billing and finance areas can share data related to timesheets.	Better "producer-consumer" relationship between Finance and the rest of areas in transferring the timesheets in a timely way.	Coordination between the project and finance areas by sharing information related to payment control	Coordination between all companies by sharing financial data and information (Creating consolidated statements).
	Decision Making Process Support	Limited use of reports from the ES.	Use of Excel (off-line) for reporting ES-related data (financial and human resources processes). Use of the ES (by tailoring) for reporting its own data related to financial accounting.	Use of the ES (via tailoring) for reporting its own data related to financial accounting.	Use of the ES for reporting its own data related to procurement & payment control.	Use of the ES for reporting its own data related to fixed assets, inflation adjustment, financial consolidation.
	Transaction Automation	Transaction automation in the following processes: financial accounting, controlling and administration in all business units; sales & procurement in the telecom unit; and time recording in EPC.	Transaction automation in the payroll process in all business units.	Transaction automation in the time recording process at the EPC regional offices	Transaction automation in part of the procurement and payment control processes for a specific EPC project	Transaction automation in the following processes: financial consolidation, inflation adjustments, assets, personnel training planning, and billing.
		Year 1 (1998)	**Year 2 (1999)**	**Year 3 (2000)**	**Year 4 (2001)**	**Year 5 (2002)**

*CWNI: Capability was not incorporated on further areas or business units

Figure 6.2.b The Infusion Process of the Transaction Automation in ESC



6.6 The ES Capabilities in CPC

6.6.1 Transaction automation

The most remarkable example of transaction automation in CPC is that of the sales cycle. This encompasses sales and financial transactions. A number of benefits were reported from both areas. From the sales area the benefits were as follows:

- A standardized flow of work independent of the sales representatives or users running the sales transactions throughout the process. This brought about uniformity and efficiency to the process, which translated into an improved delivery time.
- Processing of the data in an integrated way so that the sales orders are reflected in real time in other areas (e.g. finance and delivery). This eliminated the

redundancy of transactional data that occurred caused by having different systems and databases.

- Any user (e.g. a sales representative) can check the status of any order at a specific moment.

In the financial area the automation of the sales cycle brought about more control on the business. First, the system automatically matches the customer sales order vs. the status of the customer's outstanding accounts and its limit credit. The result is an approved order that follows into the delivery area or an unapproved order that has to be checked by the accounts receivable staff (see Figure 5.7.a and Figure 5.7.b). That is, transactional control occurs in real time. Second, the system allows the company to control sharply the customers' behaviour: accounts receivable, outstanding debts, debit notes, limit of credit. For the administration manager, "it is so difficult to carry this exhaustive control of all customers without an ES; ...it is more difficult still if one considers that CPC runs a billing process using two currencies: the national currency and US dollars[21]." The accounts receivable manager agrees with the above. She argued, "the company would be impossible to manage without this ES."

Although these important benefits have been achieved by CPC in the sales and financial areas, other transactions and processes had been slowly automated. One of them is the procurement process. In this process transaction automation had been limited to the recording of the purchase orders and the creation of the accounts payable. CPC had planned to complete the automation of the procurement

---

[21] Successive devaluation processes in this country have caused that CPC (in the case of imported products) protects itself by billing to customers in both currencies: the national currency and US$. As a consequence, successive debit notes had to be recorded to reflect the change in the value of the sale in the national currency.

area on 2002. In addition, the automation of the sales transaction in the six regional sales centres was planned to be completed on 2003. The company was committed to automate all business transactions and processes. As the CEO pointed out, "every repetitive transaction and process must be automated before 2004."

6.6.2 Decision-making process support

Finance was the only area in using appropriately this capability. At the beginning of the project, the financial staff used mainly Excel for reporting the ES-related data. Then, some standard reports began being used. These standard reports fitted very well to the area's requirements (e.g. accounts receivable in US$). However, further developments were needed to meet particular requirements. At least ten new reports were developed in the accounts receivable area. For the ES outsourcer, "the accounts receivable staff required customized reports to guarantee better control of the customers and sales representatives; ...we had to bring information from different business areas to build specific reports." For the CEO, other areas such as operations and sales were away from using this capability in the way as finance used it. Although the sales manager makes decisions using the ES data, he asks all information to the sales staff that sends it to him through papers. The CEO's expectations were that each manager could be connected to the system and access themselves all information needed. But, as he argued, "first all transactions have to be automated in order to reduce the managerial focus on transactional issues."

6.6.3 Monitoring Performance

Although this monitoring performance capability had been not activated in CPC yet, the CEO thought that they would begin to use this capability on early 2003. As mentioned before, the automation of all transactions was the priority at that time. However, in the meantime the upper-management defined the business objectives and the key performance indicators. They were represented by using the balanced scorecard approach (see section 5.4.2 and Figure 5.9). This enterprise information model would be configured in the system after the automation priorities were completed. Then, the company expected that the system would allow the upper-management to focus on management issues (e.g. monitoring performance) rather than spending a lot of time and effort on the day-to-day transactions (e.g. approve sales orders). As with the decision-making process support capability, the CEO pointed out that for exploiting appropriately the monitoring performance capability, "managers have to use the system by herself in her own desk."

6.6.4 Coordination

The most evident case of using the coordination capability in CPC was that of the sales cycle. As with the former two sites, the ES allowed CPC to manage dependencies related to *share information* and *producer-consumer* relationships. In relation to share information, by recording the customer sales orders and their distinct status in the process (e.g. entered, approved, planned to be delivered, and delivered), everybody was able to view the orders' status in real time without inquiring anyone else. This originated a major coordination improvement. According to the accounts receivable staff, before the ES sales representatives rang each person of the process to know where a particular sales order was stopped. Nowadays the sales office can view all orders in the system and answer sales representatives any question about their customer orders.

The ES has also supported coordination between areas with *producer-consumer* relationships in the sales cycle. By using the ES the company achieved to link the ordering process, the credit check process, and the delivery process in a way that the delivery time between the time of a order is placed and it is delivered was reduced to less than 24 hours (see Figure 5.7.b). Policies and procedures were also defined to reach this objective. Given that the delivery staff required filling trucks with a set of orders, the delivery staff waited by 2:00 p.m. to begin planning the load of the trucks. The accounts receivable staff checked credit condition by 2:00 p.m. for orders to be loaded in the afternoon. The sales staff promised 24 hours deliver for those orders that arrived before 12:00 noon each day. The ES encouraged a synchronised business model for the sales cycle.

Early in 2002 the CPC's procurement cycle was also using the ES for *sharing* information related to purchase orders and accounts payable between the procurement and finance areas. The company expected that late in 2002, or early in 2003, the ES could help them in managing dependencies related to *producer-consumer* in the procurement cycle. The coordination capability would also be used in 2003 to synchronize the replenishment process from the central warehouse to all regional warehouses. As with CC, CPC wanted to eliminate the inefficient practice of accumulating buffer inventory stocks in all regional warehouses as a mechanism to de-couple activities in a supply chain (Diaz 2000).

6.6.5 Customer Service

The most remarkable case of the use of customer service capability by CPC was that of guaranteeing reliable delivery times to clients. As a consequence of the automation of transactions and the improvements of coordination within the sales cycle, the delivery time from the customer order is placed to the product is delivered is assured that is less or equal than twenty-four hours. According to the sales manager, "the worst thing of the former process was that it was impossible for sales representatives to promise firm delivery dates; ...sometimes the product was delivered on time, but sometimes the product was delivered so late." Once the modelled process went live, the sales representatives were able to promise firm delivery dates and to deliver in twenty-four hours when it was required.

All of above had been translated into improved service levels. For the CEO, "in a market of commodities, like it is where we are, these improved service levels have allowed us to differentiate ourselves from competitors, which has been converted into higher margins without losing market." According to the accounts receivable manager, "the sales representatives' complaints against the company's back-office about delays in delivering have been eliminated after the system was up and running." Other cases of improved service levels related to the sales cycle were also reported by the accounts receivable manager. According to her, sales representatives and clients were receiving the status of the accounts receivable and the status of the customer orders in the time when it was asked, which was impossible before the system was implemented.

Further improved service levels would be achieved in 2003 after automating the transactions in the six regional warehouses and sales centres. As a consequence of better coordination between the central warehouse and the six regional warehouses, service levels would be improved. For instance, the sales manager was expecting that stockout in regional warehouses were eliminated. Furthermore, this automation in the regional offices is likely to allow the company to deliver the invoices to clients in the same time when the order is delivered. In the former process, although the order was processed in the central office in real time, the regional office delivered the order to the client whilst the invoice was sent later from the central office to the regional office. According to the administration manager, given that the clients consider the time when the invoice is received by them as the time for beginning the accounts receivable, the reduction of the deliver time of the invoices to the regional clients would be translated into a faster time of payment by the clients. This was an important improved service for an internal customer: the finance area.

Finally, the administration manager argued "the ES had allowed the finance area to deliver regularly better and more detailed information to the CEO and the Board Meeting than ever." This was considered by her as an important customer service to shareholders.

6.6.6 Process Management Automation

CPC had planned to implement the functionality of Distribution Requirements Planning (DRP) and Statistical Inventory Control (SIC) in 2003 (see Table 5.3 and Table 6.3). According to an ES consultant, the subsequent step after the automation of transactions in the six regional warehouses and sales offices is to automate the management of the replenishment process. The use of this capability will imply to apply sophisticated management techniques over the organization. Although the CPC's upper-management knew the DRP technique, they recognize that the company had never used it. Because of this, the company would learn new business practices. The case of SIC was different. According to the ES consultant, the company had a procurement practice for planning the purchase orders that may match with the SIC functionality. As a consequence, this administrative process would be automated.

6.7 The ES Infusion at Chemical Products Company

The infusion of the ES in CPC was also a cumulative process over time. This process has progressed over seven years (see Table 6.3). In the first year, CPC automated some transactions and tasks of the sales cycle and the procurement cycle. The decision-making process support was also activated by using Excel for reporting ES-related data and by using few standard ES reports. Over the next three years, CPC was not able to deploy these two capabilities in further areas or units inside the organization. The infusion process of these two capabilities throughout the company was congealed. This is represented in Figure 6.3.a through circles grade similarly from the first year to the fourth year in the respective rows. From the fifth year CPC continued automating transactions throughout the organization adding areas and units such as finance, sales, procurement, and the regional sales offices (see transaction automation in Table 6.3). The decision-making process support was also deployed over the same period of time. As a consequence, these two capabilities penetrated in a cumulative manner between the fifth year and the seventh year. The dashed line in Figure 6.3.a represents the infusion process for the transaction automation capability. Figure 6.3.b shows the same infusion process in a two-dimensional graph.

The coordination capability and the customer service capability were also developed from the fifth year. These two capabilities were incorporated within the organization's routine in the subsequent years, in a cumulative manner, adding areas or units (see Table 6.3 and Figure 6.3.a). The monitoring performance capability and the process management capability was planned to be used since the seventh year. As aforementioned, they would be extensively deployed throughout the organization in the subsequent years. The solid line in Figure 6.3.a represents the ES capabilities' total infusion process. This represents the way as the ES capabilities were incorporated over time. For instance, from the first year to the fourth year were just incorporated the transaction automation capability and the decision-making process support capability. This is reflected in the solid line by the horizontal part between the first year and the fourth year. From the fourth year to the fifth year two further capabilities were incorporated: coordination and customer service. No capabilities were incorporated between the fifth year and the sixth year. Finally, the monitoring performance capability and the process management automation capability would be incorporated from the seventh year, which is reflected in the solid line through a gradient between the sixth year and the seventh year.

Figure 6.3.a. The ES Infusion in CPC

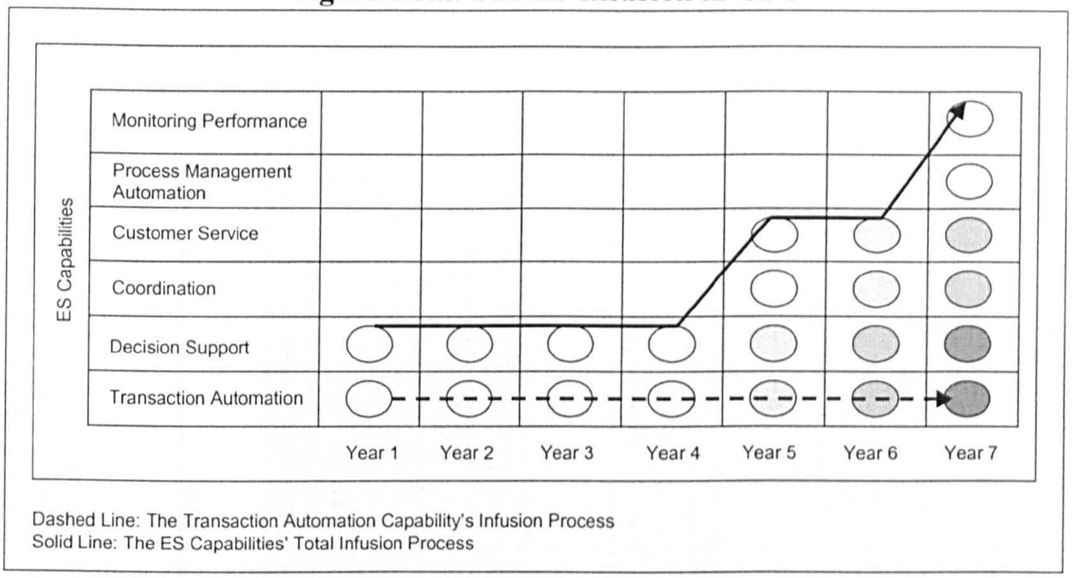


Figure 6.3.b The Infusion Process of the Transaction Automation in CPC

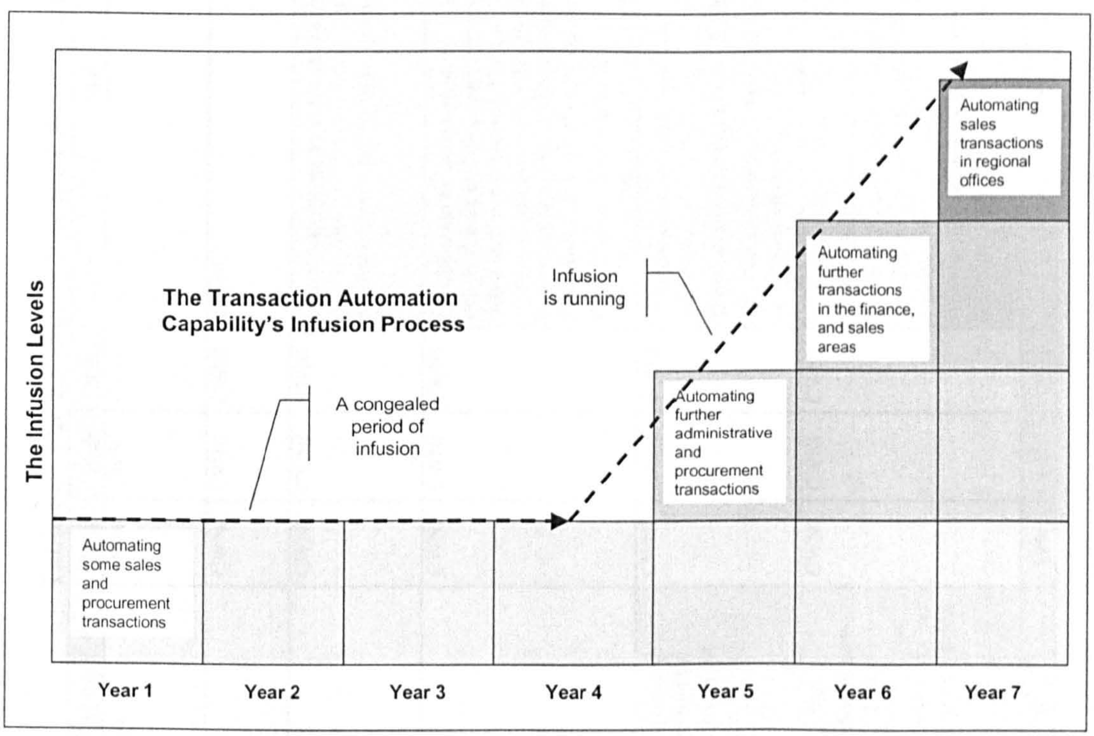


Table 6.3 The ES Impact into the CPC's Business by Time & Types of ES Capabilities

		1997	1998	1999	2000	2001	2002	2003
ES CAPABILITIES	**Process Management Automation**	CWNI*	CWNI	CWNI	CWNI	CWNI	CWNI	Plan: SIC & DRP
	Monitoring Performance	CWNI	CWNI	CWNI	CWNI	CWNI	CWNI	Plan: EIS
	Customer Service	CWNI	CWNI	CWNI	CWNI	Better customer service, which is shown through delivery times in 24 hrs, sending status of accounts receivable, and order status information when asked.	Better customer service, which is shown through stock availability and reliability.	Better customer service: stock availability in regional warehouses and document quality (e.g. date of bill equal to date of delivery note will reduce claims, reduce delivery time of bills).
	Coordination	CWNI	CWNI	CWNI	CWNI	Coordination between operations & sales: lowering delivery times and avoiding buying new trucks (there was a inefficient process). The amount of lorries was enough, although someone thought that they needed to buy new ones to reduce delivery time. Definitely, there were high costs of coordination. Coordination between sales & finance: controlling credit & accounts receivable when processing orders.	Coordination between procurement & finance: sharing information related to purchase orders and accounts payable. Coordination between procurement and central warehouse: sharing information about product reception.	Coordination between regional warehouses and central goods warehouse.
	Decision Making Process Support	Limited used of reports from the ES. Use of Excel for reporting ES-related data.	CWNI	CWNI	CWNI	Activating standard outputs to show the financial statements. Use of standard reports in sales & finance. Developing more than 10 new reports for the financial & administrative areas	Use of standard reports in finance & procurement. Developing reports for the financial & administrative areas	Use of standard reports (or developing ones) for regional sales centres.
	Transaction Automation	Transaction automation in some tasks of the sales & procurement cycles. Procurement was less developed than sales.	CWNI	CWNI	CWNI	Automating further transactions and tasks related to administration processes. This has translated into effective control of accounts receivable, accounts payable, and inventories. Automating the issuing of cheques. Automating transactions in the procurement cycle (purchase order is now registered when it occurs).	Automating further transactions and tasks in the procurement area (controlling providers, planning and budget). Further functionality in the financial areas: calculating tax retentions, registering VAT (a localization); assets; calculating budget.	Financial areas: register of debit notes to clients after calculating the differential caused by currency devaluation. Automating sales transactions in the six regional sales centres. Substitution of current manual systems.
		1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**

*CWNI: Capability was not incorporated on further areas or business units.

6.8 Discussion

This chapter has developed the ES infusion concept as part of a technological innovation perspective of the ES implementation. Two constructs were developed in order to measure the ES infusion. First, a framework of ES capabilities was developed by taking into account the IS and ES literature (Zuboff, 1988; Hirschhorn and Farduhar 1985; Doll and Torkzadeh 1998; Davenport 1998; 2000), and the findings from this investigation. The idea has been to ascertain how much the ES supports aspects of the organizational work. Six general ES capabilities were delineated: 1) transaction automation, 2) decision-making process support, 3) monitoring performance, 4) customer service, 5) coordination, and 6) process management automation. Second, the evidence from the three sites under study suggests that the use of these ES capabilities follows a cumulative process over time. The ES capabilities are incorporated in a cumulative manner by adding capabilities over time. In addition, each capability is incorporated within the organization's routine year-by-year adding areas or units each year. As a consequence, two infusion processes can be considered: the total infusion process of the ES capabilities (see the solid lines in Figures 6.1.a, 6.2.a, and 6.3.a) and the infusion process of each capability (see the dashed lines in Figures 6.1.a, 6.2.a, and 6.3.a).

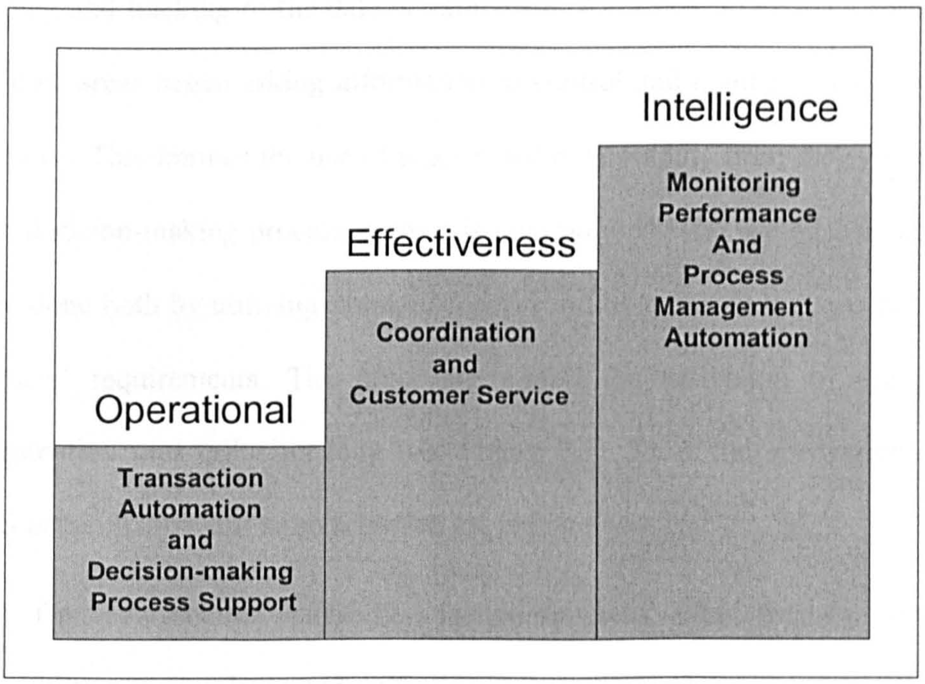
6.8.1 The Levels of the Total Infusion Process

By comparing the three sites under study, a similar pattern of the total infusion process can be identified. The ES capabilities seem to be incorporated sequentially within the organizations' routine through three sets of capabilities (see Figures

6.1.a, 6.2.a, and 6.3.a). The first set encompasses the automation transaction capability and the decision-making process support capability. The second set includes the coordination capability and the customer service capability. Finally the third set encompasses the monitoring performance capability and the process management automation capability. In all sites the transaction automation capability and the decision-making process support capability began being introduced simultaneously over the first year. The coordination capability and the customer service capability began being introduced simultaneously over the second year in CC and ESC, and over the fifth year in CPC. The monitoring performance capability and the process management automation capability were the latest capabilities being introduced in all cases. (see Figures 6.1.a, 6.2.a, and 6.3.a). This pattern can be characterized by considering such sites as ascending a three-steps staircase of infusion (see Figure 6.4). The first step can be labeled as the *operational* level (transaction automation and decision-making support process). The second step can be labeled as the *effectiveness* level (coordination and customer service). Finally, the third step can be labeled as the *intelligence* level (monitoring performance and process management automation).

These three levels are characterized below by using concepts and terms that have been borrowed from Bocij *et. al.* (1999), Markus (2000), and Davenport (2000), respectively. The *operational* level refers to the use of the ES for the day-to-day activities of a business such as transaction processing and producing reports containing information required to support the day-to-day decision-making activities (Bocij *et.al.* 1999). The *effectiveness* level occurs when companies achieves business integration to lever tighter coordination amongst discrete business activities and to serve their customers effectively (Markus 2000). The *intelligence* level implies to take action on data by two ways. First, the ES can be used for managing processes by incorporating business rules and the heuristics that humans previously used to handle them manually (Davenport 2000) – i.e. process management automation. Second, ES can be used to transformed data into knowledge through analytical capabilities (Davenport 2000) – i.e. monitoring performance.

Figure 6.4 The Three-steps Staircase of the ES Total Infusion Process



6.8.2 Linking the Total Infusion Levels and the Diffusion Model

The reason of the pattern described above can be found in the relationship between this Staircase of Total Infusion (Figure 6.4) and the Model of Internal Diffusion of ES (Figure 5.1). The relationship between diffusion and infusion was also found by Cooper and Zmud (1990) in their study of MRP adoption. For them, "adoption is necessary for infusion to occur." (p. 131). The degree of MRP infusion inside companies was related to the implementation and application of more technology's key features (Cooper and Zmud 1990). In relation to ES, the pattern of total infusion displayed in Figure 6.4 relies on the way as the ES diffusion occurs. This claim is explained below.

Transaction automation is the first capability incorporated because the implementation of the ES functionality (see the left-hand side in Figure 5.1) implies immediately the application of this capability. That is, once any ES functionality is implemented, the application of the system for the registering, recording and tracking of the data is immediate. After this, in all sites, users from individual areas began asking information to control and manage their day-to-day operations. This implies the use of reports and data outputs from the system. That is, the decision-making process support is incorporated. The use of this capability can be done both by utilizing standard reports and by tailoring the system to meet the users' requirements. The latter can imply the activation of the **system configuration and tailoring loop** (see Figure 5.1). Thus, the *operational* use of the ES is the first benefit to be achieved for companies.

The coordination capability is incorporated after two or more ES functionalities are implemented or a specific set of functionalities (or just one) is rolled out into two or more business units. Coordination is possible only as the result of the integration of two or more ES modules (e.g. human resources and finance in ESC) or the integration of two or more business units (e.g. regional warehouses and the finish-goods warehouse in CC and CPC). That is, the management of the business operations on the basis of a single, integrated set of corporate data. Looking at the Diffusion Model (Figure 5.1.) one can see that the implementation of further functionality and/or the implementation of the ES in further business units imply running the **enhancement cycle**.

The business integration also originates the incorporation of the customer service capability. As it has been argued by a number of authors (Markus 2000; Diaz 2000; James and Wolf 2000), business integration also brings about better customer service. Such business integration causes reduced cycle times and synchronized processes (James and Wolf 2000; Diaz 2000), which is translated into improved customer service. Then the *effectiveness* use (Figure 6.4) requires integration, which occurs after the *operational* level is achieved in individual areas or business units. Then, a precedence constraint exits.

The coordination and customer service capabilities can be also extended by implementing more sophisticated functionality such as business-to-business (B2B) or sales force automation (see the cases of CC and ESC). These features can be part of the ES standard functionality, can be programmed into the system (i.e. tailoring), or can be supplied by third-party providers to interface with the ES. Whether this sophisticated functionality is part of the standard ES, companies adopt them after the transactional priorities are solved. This claim was argued by the upper-management in all sites. Then, the *effectiveness* level is developed after the *operational* level. Whether the other two options are decided, companies develop them after a minimum of the standard ES functionality is implemented. Furthermore, these two last options can require the activation of the **loops** in the diffusion model (see the case of the HHCs in CC). Then, the *effectiveness* level requires sophisticated functionality and system tailoring, which occurs after a basic *operational* level is achieved.

The *intelligence* level is the most sophisticated domain that companies can develop by using an ES. Both capabilities involved in this level require sophisticated applications that can encompass from more traditional operations research techniques to human heuristic, analytical capabilities and refined algorithms (Davenport 2000). These applications can be part of the ES standard functionality or the development of bolt-on programmes by third-party vendors. The applications take action on data already recorded in the system's databases. This implies that the *operational* use has already occurred. On the other hand, the business integration (i.e. the effectiveness level) is required in this *intelligence* level because some of these techniques operate on a basis of integrated business models. This is the case of the DRP technique (see the case of CC), which suggests replenishment orders from a central warehouse into remote warehouses inside a company (i.e. the business units had been already integrated). The same occurs for monitoring performance by using an integrated performance measures system (see the case of CPC). To define cause-effect linkage and to do "drill down" to the indicators, the company data has to be previously integrated in a single repository. Then, the *intelligence* use requires that the *operational* level and the *effectiveness* level have been already incorporated.

6.8.3 The Levels of the Capability's Infusion Process

As aforementioned, each capability seems to be incorporated within the organization's routine year-by-year adding areas or units each year. This is represented through the dashed lines in Figure 6.1.a, 6.2.a, and 6.3.a. As can be seen, the levels of this second type of infusion are also related to the diffusion process (Figure 5.1). The infusion levels of the transaction automation capability in each site (Figure 6.1.a, 6.2.a, 6.3.a) are greater when further areas or business units are incorporated. The same occurs for all capabilities. In the case of the coordination capability, the ES will be most effectively operated when more areas and business units are integrated. From this view, diffusion is also a precedence constraint for achieving higher levels of infusion of each capability. As the ESC's CFO pointed out, "ESC is behind in the race of using extensively our ES. This is because we have not implemented the system in our core business area (the procurement and project function). While we do not complete this phase of our ES project, we will be under-utilizing the system." It can be argued from this claim that higher levels of infusion will be achieved by ESC in at least two capabilities after implementing the ES in the procurement and project. First, the automating of the procurement and project area will increase the levels of infusion of the transaction automation capability. Second, the incorporation of the procurement and project area will allow the company to integrate this area with the rest of the organization in a way that the levels of infusion of the coordination capability will be increased. As argued by Leidner (1999), "...the potential impact of systems is greater when a larger part of the organization is affected, such as systems integrated organization-wide (i.e. ES)..." (p. 535).

As a result of the sections 6.8.2 and 6.8.3, it is arguable that the higher levels of infusion of ES are related to higher levels of diffusion. In addition, as aforementioned, the experience of using the ES is the heart of the diffusion process (see section 5.5.1). That is, the ES implementation has to be considered as a simultaneous process of diffusion and infusion in which both processes feed and support one another.

CHAPTER 7: CONCLUSIONS

This chapter describes the major conclusions and contributions achieved in these research findings. It then identifies the implications of this study for ES research, qualitative research, and ES practice. Suggestions for future research are also described in order to develop an agenda to extend and test the emerging theoretical framework. Finally, the limitations of the study are outlined and discussed.

7.1 Conclusions of the Research and Study Contributions

This research has presented the findings of theory generation from case study evidence study relating to ES diffusion and infusion inside organizations. In presenting the evidence the study reflects the great detail and variety of the ES implementation process. The case descriptions convey the long and intense nature of ES adoption. The study has developed models that help in attaining a holistic appreciation of the complexity of this subject. In so doing, the models assist access to this complexity, allowing its description and characterization of the evidence involved. The study reveals how the diffusion and infusion of ES throughout the organizations are cumulative and virtuous processes over time.

Since a broad discussion of the research findings was covered in chapter 5 (diffusion) and chapter 6 (infusion), the discussion of conclusions and study contributions in this chapter will be succinct. The presentation is matched against the initial research objectives.

Review of the Research Objectives

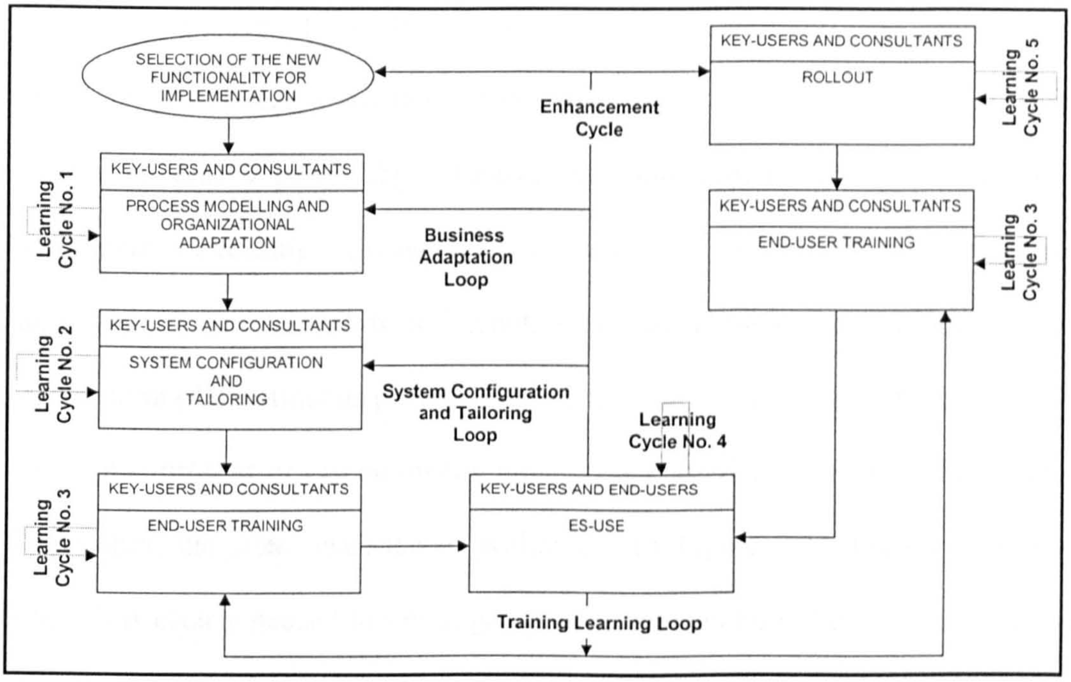
a) *To develop a model of ES diffusion that allows academics and practitioners better understanding of the activities and events occurring in the implementation and internal diffusion of ES features throughout an organization.*

The emergent diffusion model is depicted in Figure 7.1. The model is new in explaining the diffusion of ES throughout an organization under a technological innovation perspective. Four main contributions can be listed:

- The model recounts and validates the authentic characteristics of ES projects such as (a) business adaptation and (b) system configuration and tailoring. These fulfil the observations from ES literature (Markus and Tanis 2000; Brehm *et. al.* 2000; Davenport 2000).
- The model differs critically from traditional software lifecycle accounts by placing "use" in the centre of the discourse, as both product and fomenter of adoption activity. This is a very different depiction of the dynamics of software adoption to that in conventional implementation models, which rather mechanistically put use as the output to a series of preceding activities.
- Two *distinctive features* of ES diffusion appear from use as means of experiential learning: the **enhancement cycle** and the **loops** related to the business adaptation and system configuration and tailoring. The **enhancement cycle** represents the *spreading* process of the innovation (the ES) throughout the organization. This cycle encompasses both the implementation of further ES functionality and the rollout of functionality already implemented into further business areas or units. The **loops** represent the *technological*

adaptation between the innovation (the ES) and the organization. A positive feedback in the **enhancement cycle** and in the **loops** motivates the full incorporation of the ES across the organization and plentiful adaptation between the organization and the system.

Figure 7.1 The Model of Internal Diffusion of ES



➢ The new perspective puts rather more emphasis upon the importance of experiential learning. By using the ES, organizations achieve better understanding of (1) the ES and its ramifications and (2) their own organizational needs. We can notice several reflective accounts from actors in three sites as they identify "mismatch between intentions and outcomes" (Argyris 1992). The model thus presents ES diffusion as a learning process through activities associated with its adoption. Experiential learning, as described by Kolb (1984), was the way that key-users and end-users in all three cases acquired knowledge necessary for ES adoption, and is notable in its importance in relation to the deficiency of knowledge transfer from ES consultants.

Finally, by contrasting ES diffusion amongst the sites under investigation, the study reveals differences in the timing of two *distinctive features* of the ES diffusion (i.e. the enhancement cycle and the loops). By tying the emergent theory to existing literature (Tyre and Orlikowski 1994; Kimberly 1981; and Rogers 1995), a theoretical framework has been developed to characterize these differences (see Figure 7.2). Hence, the enhancement cycle can follow a continuous spreading process throughout the organization (continuous improvement) or can follow a discontinuous spreading process throughout the organization (discontinuous process). In addition, the loops can also follow either a continuous process or discontinuous process. A classification matrix was yielded for locating the sites' experiences within it (see Figure 7.2). Further empirical research is clearly needed to investigate this model and how the different contexts and specific process factors influence these timing patterns.

Figure 7.2 The Timing of the Two Distinctive Features of ES Diffusion

		Temporal Pattern	
		Continuous Improvement	**Discontinuous Process**
The Distinctive Features of ES Diffusion	**The Enhancement Cycle**	1 *Continuous Spreading throughout the company* (CC)	2 *Discontinuous Spreading* (ESC, CPC)
	The Loops (Technological Adaptation)	3 *Continuous Technological Adaptation* (CC, ESC)	4 *Discontinuous Technological Adaptation* (CPC)

b) *To develop a model of ES capabilities (ES uses) and apply this model to analyse how ES infuse inside organizations.*

First, this study has developed a model of ES capabilities to analyse the extent and quality of the use of ES in organizational contexts (i.e. infusion). These capabilities are defined as those provided by ES to perform and support certain organizationally relevant functions. The model itself was initially formulated from concepts in IS and ES literature and from the pilot study. Then, the model was re-applied, validated and tuned through all three sites under study. The model consists of six general ES capabilities that can be used and deployed by organizations: 1) transaction automation, 2) decision-making process support, 3) monitoring performance, 4) customer service, 5) coordination, and 6) process management automation (see Table 7.1 for a brief description and section 6.1 for a detailed description). The use of a multidimensional framework has allowed recognizing the organizational functions for which ES are utilized and has allowed better characterisation of the extent and quality of the ES use.

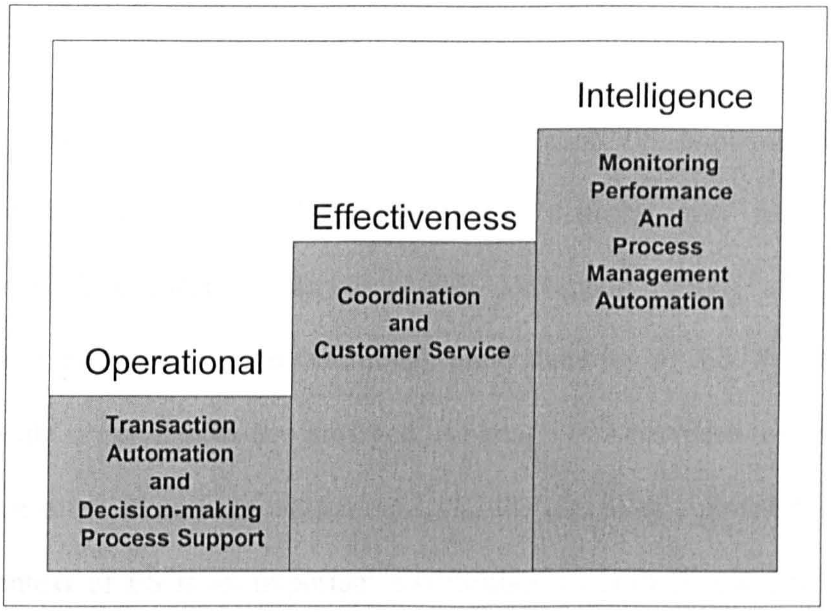
Once the ES capabilities model was validated, ES infusion was analysed and characterized. The study has analysed the levels of infusion at a particular time by considering two indicators: 1) the number of business areas and units that has been affected by each ES capability and 2) the number of ES capabilities incorporated. Hence, two cumulative infusion processes were identified. First, once the capability is incorporated, it is infused within the organization's routine year-by-year by adding business areas (e.g. the transaction automation capability was progressively incorporated in each site's areas). Second, the ES capabilities are further incorporated in within the organization by adding capabilities over time.

Table 7.1 The ES Capabilities Model

ES Capability	Definition
Transaction Automation	This capability can be defined as utilising ES to automate business transactions in order to perform them with more uniformity and control. Such capability includes processing data in an integrated and standardized manner, standardized flow of work, transaction control through business rules, and the possibility of tracking transactions and data.
Decision-making Process Support	This capability is concerned with business decision-making based on data provided by ES.
Monitoring Performance	This capability is concerned with the recording and monitoring of performance indicators. Typically this is achieved through management information tools, which give direct access to key performance measures of a company.
Coordination	Coordination is seen as a response to troubles caused by dependencies. Typical dependencies that may be handled by ES are those defined as "share resource" and "producer-consumer". In the ES context, *share resource* can be seen as sharing the same body of information between different departments or business units that require it simultaneously. *Producer-consumer* is concerned with synchronizing activities or processes embedded in a value chain so that the resource required by the consumer is available when needed.
Customer Service	This capability is concerned with using ES to provide differentiated and customized service to internal and external clients.
Process Management Automation	This capability is concerned with the automating of administrative processes. That is, the ability of ES to take action on data by incorporating business rules and the heuristic that business specialists previously used to manage the process manually.

Although each site follows a unique infusion process, it was found that all of them follow a similar pattern of introduction of the ES capabilities. Initially, the transaction automation capability and the decision-making process support capability were introduced simultaneously over the first year. Then, the coordination capability and the customer service capability were subsequently introduced. Finally, the monitoring performance capability and the process management automation capability were introduced. This emergent ES infusion pattern was linked to the existing literature (Bocij *et. al.* 1999; Markus 2000; and Davenport 2000).

Figure 7.3 The Three-steps Staircase of ES Infusion



The pattern can be characterized by considering such sites as ascending a three-steps staircase of infusion (see Figure 7.3). The *operational* level refers to the use of the ES for the day-to-day activities of a business such as transaction processing and producing reports containing the information required to support the day-to-day decision-making (Bocij *et. al.*, 1999). The *effectiveness* level occurs when companies achieve business integration to lever tighter coordination amongst discrete business activities and to serve their customers effectively (Markus 2000). The *intelligence* level implies to take action on data in two ways. First, the ES can be used for managing processes by incorporating business rules and the heuristics that humans previously used to handle manually (Davenport 2000) – i.e. process management automation. Second, ES can be used to transform data into knowledge through analytical capabilities (Davenport 2000) – i.e. monitoring performance. Rising up the staircase of infusion implies that the organization is achieving more aggregated and sophisticated uses of ES.

7.2 Implications to ES Research and Suggestions for Future Research

This research has studied the ES implementation process under a technological innovation perspective. This broader perspective upon ES implementation has allowed insight into the ES phenomenon in a different way from existing frameworks such as those of Markus (2000), Davenport (2000), and Bancroft (1998). As a consequence, an additional understanding of ES diffusion and infusion inside organizations has emerged. Although this perspective has already been used in other IS and innovation contexts, the use of this perspective in the changed context of ES is an important contribution to both IS and ES research. Then, further to this, the peculiar processes of adoption, diffusion and infusion of ES within organizations have emerged in this study that can be compared to those of other sorts of information systems, and contribute to that wider understanding (e.g. see that of Cooper and Zmud 1990).

The emergent ES diffusion model has allowed the identification of important implementation activities beyond the ES installation such as organizational adaptation, experiential learning, enhancement cycles and feedback loops. Further, the model incorporates the use of the system as product and fomenter of adoption activity, a very salient point of comparison to conventional implementation models that consider use just as an output. The emergent ES infusion model has brought about the identification of ES capabilities in supporting organizational functions and the characterisation of a pattern of introduction and uses of these capabilities (i.e. infusion). By looking at ES implementation as an effort in technological diffusion and infusion within a user community, the research has also contributed to characterize it as iterative, cumulative and virtuous process over time.

In order to enrich the constructs developed here and yield more understanding of ES diffusion and infusion phenomenon, more empirical comparisons are clearly needed. Four initial strategies for further research are proposed in turn below.

First, it is necessary to investigate what contextual factors determine the different timings of diffusion and the distinct infusion patterns. The innovation and information systems literature suggests some hints to study the contextual forces contributing to efforts to introduce technological innovations into organizations. For example, Kwon and Zmud (1987) have identified five major contextual factors. They are related to characteristics of the user community, characteristics of the organization, characteristics of the technology being adopted, characteristics of the task to which the technology is being applied, and characteristics of organizational environment. Anecdotal reports exist from the three sites under study that can contribute to an initial identification of these factors influencing the way as the diffusion and infusion processes occur. These findings require further investigation, but have validity insofar as they emerge from empirical data. Some of these factors were user skills (e.g. learning ability), users′ previous knowledge related to ES, formal and informal networks to leverage the knowledge creation (e.g. users′ learning committee and ES long-term organization), compatibility between the organization tasks and the system, complexity of the tasks and processes where the system is being implemented, inter-organizational dependence with others companies in a supply chain or industrial network, and flexibility of the ES to fit to the organization's requirements.

Secondly, some research findings seems to suggest that the ES diffusion model could be extended to consider specific ES events, which are particular in some organizations implementing ES. For example, in ESC it was found that the organization had to adapt the system to follow country specific laws (e.g. social insurance and fiscal laws). This sort of event is called by some ES providers as doing 'country specific customisations' or 'localizations' (e.g. SAP). Once a localization is done it becomes part of the system standard functionality. However, the development of a localization is a shared task between the provider and several organizations implementing the system. When it occurs in an organization, novel events and activities arise related to the process modelling and system configuration and tailoring boxes within the diffusion model (see Figure 7.1), suggesting that further research can be carried out to delineate this more clearly.

Another specific event that has not been reflected in the diffusion model is that of upgrading. Upgrades occur few years after the organization implements the ES functionality and carries through a process of rollout to further business units. In this study upgrades occurred only in the ESC case. Although it might be considered that upgrades bring only technical challenges to the organization, it is perhaps more likely that they will necessitate their own diffusion activities. New releases have new functionality. As a consequence, organizations will iterate through the diffusion model to implement such functionality, although the specific character of diffusion activities for upgrade are likely to differ vis a vis diffusion activities for early adoption. It remains interesting to explore this area, however, for by encompassing upgrades, the model becomes relevant to the whole lifetime of the ES. We can speculate that new releases can imply new features in current functionality, necessitating the re-modelling of business processes and/or reconfiguring of system parameters already implemented. New releases might also affect early developments and interfaces, implying running again a system tailoring activity. Finally, each of these events can involve training and learning activities.

Thirdly, the implementation of ES under a diffusion and infusion perspective brings important organizational challenges in terms of managing a long-term, iterative and cyclical project. How should organizations organize themselves for managing such projects? Evidence from the sites under study shows that organizations need to develop long-term teams that have the responsibility of executing the diffusion and infusion processes and acting as learning communities. Evidence also reveals that organizations have to decide between doing some of the diffusion activities (e.g. system configuration and tailoring) by themselves (i.e. in sourcing) and contracting third-parties (i.e. outsourcing). In addition, organizations have to develop mechanisms to (a) reduce the burden of learning and (b) speed the system diffusion and infusion. An important question is: How can an organization do diffusion and infusion efficiently, not just effectively? After all, organizations need to return investment sooner rather than later. Faced with all of this, it is perhaps clear that organizations and ES providers have to continuously innovate in the development of project teams and methodologies in order to tackle these challenges in new contexts and domains.

Fourthly, the model restates one of the most interesting ES challenges: that of doing business adaptation and system tailoring to close the gap between the organizational processes and practices and the systems business models. Some authors (e.g. Rosemann *et. al.* 2001) have investigated the problem under a processes modelling perspective. Others (e.g. Brehm *et. al.* 2000) have studied how to close the gap by tailoring the system. Although this study has described evidence that shows how the organizations under study solved this challenge, it suggests that further research is needed in order to develop methodologies to tackle this specific question.

Finally, the research agenda should consider the development of multiple methodologies from theory-building, further replication case studies to fine-tune emerging models, and theory-testing empirical studies. This may follow the Galliers' approach to achieve theory extension after doing theory-building and theory-testing. (Galliers 1992).

7.3 Implications for Qualitative Research

Although a number of authors have developed a set of procedures, steps, or rules of application for doing qualitative research, there is no ideal or unique technique. "Qualitative research may be conducted in dozens of ways" (Miles and Huberman 1994; p. 5). For example, techniques can depend on the types of qualitative research (e.g. ethnography, case study research, process research, and grounded theory) and can depend on the part of the flow of activities in execution (e.g. research design, data collection, data reduction, and conclusion drawing). Moreover, in each of them the researcher can find different suggestions or procedures. In comparison to quantitative research, qualitative research is less structured. While quantitative research is carried out through well-defined and familiar methods, qualitative research is in a more fluid position (Miles and Huberman 1994). This brings particular challenges to qualitative researcher in terms of documenting his/her research process in detail in order to allow ones to audit the investigation and allow others to learn and reuse the technique.

In the light of the above, this study has attempted to codify the steps followed by the researcher in the derivation of theory. This has resulted in an iterative and cyclical algorithm to generate theory from case study evidence. The algorithm encompasses the activities and cycles that allowed the researcher to define a research focus, collect data, analyse data, and generate theory. The procedure does not attempt to be a single, archetypal way of carrying out this type of qualitative research. In fact, the algorithm reflects procedures and techniques from a number of authors (Eisenhardt 1989; Pettigrew 1990; Glaser and Strauss 1967; Miles and Huberman 1994, Yin 1994). In comparison to further algorithms (e.g. that of Eisenhardt 1989), its contribution is as follows:

1. It validates the iterative nature of theory generation from case study evidence research in terms of cycles of induction and deduction.
2. It introduces the pilot case study as a key activity in the clarification and identification of initial constructs that can help to shape the research design.
3. It highlights the important role of the first site (after the pilot case study) in the aim of achieving a more focused theme and fine-tuning the research questions.

7.4 Implications to ES Practice

This study has addressed one of the most recent of practitioners' concerns around the ES phenomenon – those of the diffusion of the system beyond the first installation and the infusion of the system to realize the expected benefits. Professional magazines (e.g. Computerworld and IndustryWeek) and independent research analysts (e.g. AMR) have revealed that managers and consultants are disappointed because ES is sometimes partially implemented and deployed (O'Brien 2002; Shepherd 2001).

The main implication for practitioners in general is better understanding of the processes of diffusion and infusion of ES inside organizations that will contribute to better planning, executing and monitoring of implementation processes. For example, the study will allow practitioners to understand the ES implementation as 1) a long-term project, 2) an iterative, cumulative and cyclical process, and 3) a knowledge creation process. The understanding of these issues will bring changes in the way as project teams and organizations will manage themselves an ES project. To consultants and ES providers, the models can originate the need of developing methodologies that help organizations to manage the ES as a technological innovation.

7.5 Limitations of Study

Since the ES implementation phenomenon is in its early stages of research and implies the study of process-related issues, the theory generation from case study evidence was considered as the most appropriate methodology to achieve the aims of this research. However, some methodological characteristics that lead to strengths also lead to weaknesses. Any choice implies a trade off. Then, a number of potential limitations of this research are apparent and must be considered. These limitations are outlined below alongside some debate about their nature and some possible ways to overcome them:

1. The models developed here emerged from the study of three sites. This would suggest that the resulting theory is narrow and idiosyncratic and it is not

generalizable beyond the sites' particular contexts. This is a common argument from the positivist stance. However, the findings of this study are potentially generalizable through replications of them in further sites (i.e. analytical generalization, instead of statistical generalization). Then, the resulting theoretical framework can become the vehicle for generalizing to new cases. In addition, the models' constructs may be testable with hypotheses that can be proven. As Eisenhardt (1989) points out, "grand" theory requires multiple studies – an accumulation of both theory-building and theory-testing empirical studies.

2. As with each qualitative data analysis research, this study had the risk of being biased by the researcher's own preconceptions and interpretations. Although the researcher used a number of tactics to reduce this risk, it is possible that bias remains. For example, the researcher is self-aware about the personal assumption about that the complex technologies need time and big efforts to be assimilated by organizations. However, it is important to note that the use of well-proven tactics have guaranteed the quality of the study's conclusions in terms of objectivity, reliability, internal validity, and external validity. For example, the general methods and procedures have been described in detail, data were collected across a full range of respondents and times, findings include sufficient thick descriptions of phenomena, there was triangulation by data source and by method, findings were linked to prior theory, and the conclusions have been explicitly linked to data.

3. It is important to note that this study has been carried out in Western organizations, which may manage ES implementation differently from other (e.g. Asian) organizations. In fact, some works (Soh *et. al.* 2000) have found

that the implementation of ES in Asian companies have been troubled because of the differences between the Western and Eastern business models. This suggests that some activities of the diffusion and infusion models, and their relationships, may be adjusted in order to fit these differences. For example, the process modelling and system configuration and tailoring activities may be very distinct in order to close these cultural gaps between distinct societies.

REFERENCES

Abarca, L. and González, G. 2000. "A Taxonomy of Coordinating Information Technologies", *Proceedings of the IVth World Multiconference on Systemics, Cybernetics & Informatics*, Orlando, USA.

Agarwal, R., Krudys, G. and Tanniru, M. 1997. "Infusing Learning into the Information Systems Organization", *European Journal of Information Systems* 6, 25-40.

Allen, J. 2000. "Information Systems as Technological Innovation", *Information Technology and People*, 13 (3), 210-221.

AMR Research Report. 1999. "AMR Research predicts ERP Market will reach $ 66.6 billion by 2003", (www.amrresearch.com/pressroom/files/99518.as)

Argyris, C. 1992. *On Organizational Learning*, London: Blackwell Publishers.

Argyris, Ch. and Schon, D. 1978. *Organizational Learning: A Theory of Action Perspective*, Cambridge, Mass: Addison-Wesley Publishing Company.

Attewell, P. 1992. "Technology Diffusion and Organizational Learning: The Case of Business Computing", *Organization Science,* 3 (1), 1-19.

Baan. 2000. "Baan Education Manual", *unpublished report* (on CD-ROM).

Bancroft, N. 1998. *Implementing SAP R/3 - How to introduce a large system into a large organization*, Greenwich: Manning Publications Co.

Bashein, B. J. and Markus, M. L. 2000. *Data Warehouse: More than just mining*, Morristown, NJ: Financial Executives Research Foundation.

Bashein, B.J., Markus, M.L. and Finley, J.B. 1997. *Safety Nets: Secrets of Effective*

Information Technology Controls, Morristown, NJ: Financial Executives Research Foundation.

Becerra-Fernández, I., Murphy, K. and Simon, S. 2000. "Integrating ERP in the Business School Curriculum", *Communications of the ACM,* 43 (4), 39-41.

Bechmarking Partners. 1997a. "Elf Atochem North America - SAP R/3 Implementation Case Study", Benchmark Implementations Series, Cambridge.

Bechmarking Partners. 1997b. "Hoechst Marion and Roussel (Venezuela) - SAP R/3 Implementation Case Study", Benchmark Implementations Series, Cambridge.

Bessant, J. 1993. "The Lessons of Failure - Learning to Manage New Technology", *International Journal of Technology Management*, 8 (3), 197-215.

Bhaskar, R. 1978. *A Realist Theory of Science*, Hassocks, England: Harvester Press.

Bhaskar, R. 1989. *Reclaiming Reality*, London: Verso.

Bhattacherjee, A. 2000. "Beginning SAP R/3 Implementation at Geneva Pharmaceuticals", *Communications of the Association for Information Systems*, Vol 4, Article 2.

Bleicher, J. 1982. *The Hermeneutic Imagination: Outline of a Positive Critique of Scientism and Sociology*, London: Routledge and Kegan Paul.

Bocij, P., Chaffey, D., Greasley, A. and Hickie, S. 1999. *Business Information Systems. Technology Development and Management.* London: Pitman Publishing.

Brehm, L. and Markus, M. 2000. "The Divided Software Life Cycle of ERP Packages", *Proceedings of The Global IT Management Conference.*

Brehm, L., Heinzl, A. and Markus, M. L. 2000. "Tailoring ERP Systems: a spectrum of choices and their implications", *Proceeding of the 34th Annual Hawaii International Conference on Systems Science.*

Brown, L. 1981. *Innovation Diffusion.* London: Methuen.

Brown, C. and Vessey, I. 2001. "NIBCO's Big Bang", *Communications of the Association for Information Systems*, 5 (1).

Buckhout, S., Frey, E. and Nemec, J. 1999. "Making ERP Succeed: Turning Fear Into Promise", *Technology*, 15.

Caldwell, B. and Stein, T. 1998. "Beyond ERP: New IT Agenda", *InformationWeek On Line*, November, (http://www.informationweek.com /711/11iuerp.htm).

Caplan, N. and Nelson, S. 1981. "On Being Useful: The Nature and Consequences of Psychological Research on Social Problems", *American Psychologist*, 75, 975-987.

Christopher, M. 1992. *Logistics and Supply Chain Management: Strategies for Reducing Costs and Improving Services,* London: PITMAN Publishing.

Chung, S. H., and Snyder, C. 2000. "ERP Adoption: A Technological Evolution Approach", *International Journal of Agile Management Systems*, 2(1).

Ciborra, C. and Andreu, R. 1996. "Organizational Learning and Core Capabilities Development: The Role of IT", *Journal of Strategic Information Systems*, 5, 111-127.

Cohen, W. and Levinthal, D. 1990. "Absorptive Capacity: A New Perspective on Learning and Innovation", *Administrative Science Quarterly*, 35, 128-152.

Computerworld. 2000. "In Search of ERP Paybacks", *Computerworld,* February, (http://www.computerworld.com/careertopics/careers/skills/story/0,10801,41382,00.html).

Cooper, R. and Zmud, R. 1990. "Information Technology Implementation Research: A Technological Diffusion Approach", *Management Science*, 36 (2), 123-139.

Cotteleer, M. 1998. "Cisco Systems, Inc.: Implementing ERP", Case 9-699-022, Boston: Harvard Business School Publishing.

Couillard, G., Booth, R. and Boudreau, A. 1999. Managing SAP Knowledge Transfers. In *Systems Integration Success.* Ed by Wyzalek, J., USA: Auerbach.

Crowley, A. 1999. "Training Treadmill. A Rigorous Plan of End-User Education is Critical to Whipping ERP Systems into Shape", *PC Week On Line,* January 4.

Crowston, K. 2001. "A Taxonomy of Organizational Dependencies and Coordination Mechanisms", *MIT Papers*, (http: ccs.mit.edu/papers /CCSWP174.html).

Curran, T. and Keller, G. 1998. *SAP R/3 Business Blueprint - Understanding the*

Business Process Reference Model, Prentice Hall.

Daft, R. 1982. "Bureaucratic versus Nonbureaucratic Structure and The Process of Innovation and Change", In *Research in the Sociology of Organizations,* Ed by Bacharach, S., JAI Press.

Davenport, T. 1998. "Putting the enterprise into the enterprise system", *Harvard Business Review,* 76 (4), 121-131.

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

Davenport, T. and Short, J. 1990. "The New Industrial Engineering: Information Technology and Business Process Redesign", *Sloan Management Review*, 31 (4), 11-27.

Delone, W. and Mclean, E. 1992. "Information Systems Success: The Quest for the Dependent Variable", *Information Systems Research,* 3 (1), 60-95.

Dewey, J. 1938. *Experience & Education.* Scribner Publications. Reprint edition 1997.

Diaz, A. 2000. "E-Business: From Demand Networks to Techno logistics", *Supply Chain Forum – An International Journal*, No. 1, A Bordeaux School of Business Publication.

Dilthey, W. 1976. *Selected Writings,* Cambridge, England: Cambridge University Press.

Dobson, P. 2000. "Critical Realism and Information Systems Research: Why Bother with Philosophy", (http://www.informationr.net/ir/7-2/paper124.html).

Doll, W. and Torkzadeh, G. 1998. "Developing a multidimensional measure of system-use in an organizational context", *Information and Management*, Vol. 33.

Easterby-Smyth, M., Crossan, M. and Davide, N. 2000. "Organizational Learning: Debates Past, Present and Future", *Journal of Management Studies*, 37 (6).

Eisenhardt, K. 1989. "Building Theories from Case Study Research", *Academy of Management Review*, 14 (4), 532-550.

El Sawy, O. 1985. "Implementation by Cultural Infusion: An Approach for Managing the Introduction of Information Technologies", *MIS Quarterly*, 131-140.

Escalle, C. and Cotteleer, M. 1999. "Enterprise Resource Planning", Technology Note No. 9-699-020, Boston: Harvard Business School.

Esteves, J. and Pastor, J. 2001a. "Enterprise Resource Planning Systems Research: An Annotated Bibliography", *Communications of the Association for Information Systems*, 7 (8).

Esteves, J. and Pastor, J. 2001b. "Analysis of Critical Success Factors Relevance Along SAP Implementation Phases", *Proceedings of the Seventh Americas Conference on Information Systems.*

Ettlie, J. 1992. "Organization Integration and Process Innovation", *Academy of Management Journal*, 15 (4), 795-827.

Galliers, R. D. 1992. "Choosing Information Systems Research Approaches", In *Information Systems Research*, Edited by Galliers, R., Oxford: Blackwell Publications.

Garvin, D. A. 1993. "Building a Learning Organization", *Harvard Business Review*, July-August, 81-91.

Gilbert, A. 1999. "IT Brings Manufacturers Closer to Customers - Internet apps, packaged software help companies cut costs and improve services", *InformationWeek*, September, (http://www.informationweek.com/754/prmanu.htm)

Glaser, B. and Strauss, A. 1967. *The Discovery of Grounded Theory,* New York: Aldine.

Glesne, C. and Peshkin, A. 1992. *Becoming Qualitative Researchers,* White Plains, NY: Longman.

Goodhue, D. and Thompson, R. 1995. "Task-Technology Fit and Individual Performance", *MIS Quarterly*, 213-235.

Greenberg, J. 1995. "Baan lands Triton 3.0 multiple factory sites", *Infoworld*, 16.

Gumaer, R. 1996. "Beyond ERP and MRP II", *IIE Solutions*, 29 (9), 32-36.

Hammer, M. 1990. "Reengineering Work: Don't Automate, Obliterate", *Harvard Business Review*, July-August, 104-112.

Harre, R. and Madden, E. 1975. *Causal Powers: A Theory of Natural Necessity,* Oxford, England: Blackwell.

Hibbert, L. 2001. "Cut to the Core", *Professional Engineering,* 14 (13).

Hirschhorn, L. and Farduhar, K. 1985. "Productivity, technology and the decline of the autonomous professional", *Office: Technology and People,* 2, 245-265.

Hirt, S. and Swanson, E. 1999. "Adopting SAP at Siemens Power Corporation", *Journal of Information Technology*, 14, 243-251.

Hislop, D., Newell, S., Scarbrough, H. and Swan, J. 2000. "Networks, Knowledge, and Power: Decision Making, Politics, and the Process of Innovation", *Technology Analysis and Strategic Management*, 12 (3), 399-411.

Holland, C. and Light, B. 1999. "A Critical Success Factors Model for ERP Implementation", *IEEE Software*, May-June, 30-36.

Huber, G. and McDaniel, R. 1986. "The Decision Making Paradigm of Organizational Design", *Management Science* 32 (5), 572-589.

Irving, S. 1999. "Managing ERP Post-Implementation", *Manufacturing Systems*, 17 (2), 24-25.

Ives, B. and Olson, M. 1984. "User Involvement and MIS Success: A Review of Research", *Management Science*, 30 (5), 586-603.

James, D. and Wolf, M. 2000. "A Second Wind for ERP", *The McKinsey Quarterly*, 2, 100-107.

Jendry, R. 2000. *BaanERP Business Solutions*, Premier Press, Inc.

Jones, M. 2001. "Organizational Knowledge Sharing and ERP: An Exploratory Assessment", *Proceedings of the Seventh Americas Conference on Information Systems.*

Kawalek, P. and Wood-Harper, T. 2002. "The Finding of Thorns: User Participation in Enterprise Systems Implementation", *Data Base*, 33 (1), 13-22.

Kim, D. 1993. "The Link Between Individual and Organizational Learning", *Sloan Management Review*, Fall, 37-50.

Kimberly, J. 1981. "Managerial Innovation", In *Handbook of Organizational Design. Vol 1. Adapting Organizations of their Environments,* Ed by Nystrom, P. and Starbuck, W., Oxford: University Press.

Knapp, C. and Shin, N. 2001. "Impacts of ERP Systems Selection and Implementation", *Proceeding of the Seventh Americas Conference on Information Systems.*

Kolb, D. 1984. *Experiential Learning: Experience as the Source of Learning and Development,* New Jersey: Prentice Hall.

Konicki, S. (2000). "Invensys takes control of slumping Baan", *InformationWeek,* July 31st, (http://www.informationweek.com/797/btn.htm)

Krill, P. 2002. "Peoplesoft increasing efforts in vertical CRM apps", *InfoWorld,* February, (http://www.infoworld.com/article/02/02/28/020228hnpeople_1.html)

Kwon, T. and Zmud, R. 1987. "Unifying The Fragmented Models of Information Systems Implementation", In *Critical Issues in Information Systems Research.* Edited by Boland, R. and Hirschheim, R., Wiley Series in Information Systems.

Leidner, D. E. 1999. "Information Technology and Organizational Culture", In *Strategic Information Management,* Edited by Galliers, R. and Leidner, D. and Baker, S., London: Butterworth Heinemann

Leonard-Barton, D. 1988. "Implementation as mutual adaptation of technology and organization", *Research Policy,* 251-267.

Leonard-Barton, D. 1995. *Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation,* Boston, Massachusetts: Harvard Business School Press.

Lewin, K. 1952. "Group Decision and Social Change", In *Readings in Social Psychology.* Edited by Newcomb and Hartley, New York: Henry Holt and Company.

Light, B. 2001. "The Maintenance Implications of the Customization of ERP Software", *Journal of Software Maintenance: Research and Practice,* 13 (6), 415-429.

Light, B., Holland, C. and Wills, K. 2001. "ERP and Best of Breed: A Comparative Analysis", *Business Process Management Journal*, 7 (3), 216-224.

Lorenzo, O. 1998a. "Implantación del Sistema SAP R/3 en CANTV Servicios", Caso de Estudio No. 16, Ediciones IESA.

Lorenzo, O. 1998b. "Implantación de Sistemas Integrados: QUISOLVEN", Caso de Estudio No. 28, Ediciones IESA.

Lorenzo, O. 1998c. "Sistemas Integrados de planificación y gestión: ¿cómo se prepara la empresa para los nuevos tiempos?", *Debates IESA*, Octubre-Diciembre.

Lorenzo, O. 2001a. "Human, Contextual and Processual Issues influencing Enterprise System-Use", *Proceedings of the Seventh Americas Conference on Information Systems*, Boston, USA.

Lorenzo, O. 2001b. "Au delá de l'ERP: Internet et l'intelligence des affaires", *Connaissance Action - Publication Du Group ESC Bordeaux*, 12, 38-41.

Lorenzo, O. and Pinero, M. 2001. "Introducing ERP in the Business School Curriculum: The Case of IESA", *Proceedings of the 2001 Annual Conference of the Business Association of Latin Americas Studies (BALAS).*

Lozinsky, S. 1998. *Enterprise-Wide Software Solutions. Integration Strategies and Practices,* USA: Addison-Wesley.

Malone, T. and Crowston, K. 1994. "The Interdisciplinary Study of Coordination", *ACM Computing Surveys*, 26 (1), 87-119.

Markus, M. 2000. "Paradigm Shifts - E-Business and Business / Systems Integration", *Communications of the Association for Information Systems*, 4 (10).

Markus, M. and Tanis, C. 2000. "The Enterprise Systems Experience - From Adoption to Success", In *Framing the Domains of IT Research: Glimpsing the Future Through the Past,* Edited by Zmud, R., Cincinnati: Pinnaflex Educational Resources.

Markus, M., Axline, S., Petrie, D. and Tanis, C. 2000. "Learning from adopters' experiences with ERP: problems encountered and success achieved", *Journal of Information Technology*, 15, 245-265.

Markus, M., Tanis, C. and Fenema, P. 2000. "Multisite ERP Implementations", *Communications of the ACM*, 43 (4), 42-46.

McAfee, A. 1997. "Vandelay Industries Inc.", Case 9-697-037, Boston: Harvard Business School Publishing.

Miles, M. and Huberman, A. 1994. *Qualitative Data Analysis. An Expanded Sourcebook*, 2nd Edition, California: Sage Publications.

Miller, S. 1998. *Accelerated SAP: Implementation at the Speed of Business*, 1st edition, McGraw-Hill.

Mingers, J. 2000. "The Contribution of Critical Realism as An Underpinning Philosophy for OR/MS and Systems", *Journal of the Operational Research Society*, 51, 1256-1270.

Nandhakumar, J. 1996. "Design for Success? Critical Success Factors in Executive Information Systems Development", *European Journal of Information Systems*, 5, 62-72.

Nelson, K. and Somers. T. 2001. "Exploring ERP Success from and End-User Perspective", *Proceedings of the Seventh Americas Conference on Information Systems.*

Newell, S., Tansley, C. and Huang, J. 2001. "Knowledge Creation in an ERP Project Team: The Unexpected Debiliting Impact of Social Capital", *Proceedings of the Seventh Americas Conference on Information Systems.*

Ng, J., IP, W. and Lee, T. 1999. "A Paradigm for ERP and BPR Integration", *International Journal of Production Research*, 37 (9), 2093-2108.

Ni, Y. and Kawalek, P. 2001. "When the Dust Settles: A Study of Users after Implementation of an ES in a Local Government Authority", *Proceedings of the European Conference on E-Government.*

O'Brien, K. 2002. "Value-Chain Report – Supply Chain and ERP: Getting the Most out of Your Investment", *IndustryWeek*, June, (http://www.iwvaluechain.com/ Columns/columns.asp?ColumnId=869)

Olson, K. and Disabatino, J. 2000. "Baan is rescued, but users' concerns remain", *Computerworld*, 34 (23).

Orlikowski, W. and Robey, D. 1991. "Information technology and the Structuring of Organizations", *Information Systems Research*, 2 (2), 143-169.

Orlikowski, W. 1993. "CASE Tools as Organizational Change: Investigating Incremental and Radical Changes in Systems Development", *MIS Quarterly*, September, 309-341.

Parker, K. 1996. "The Enterprise Endeavour", *Manufacturing Systems*, 14 (1), 14-20.

Parr, A., Shanks, G. and Darke, P. 1999. "Identification of Necessary Factors for Successful Implementation of ER Systems", In *New Information Technologies in Organizational Processes - Field Studies and Theoretical Reflections on the Future of Work,* Edited by Ngwenyama, O., Kluwer Academic Publishers.

Pedler, M., Burgoyne, J. and Boydell, T. 1991. *The Learning Company: A Strategy of Sustainable Development,* England: McGraw-Hill Book Company.

Pettigrew, A. 1990. "Longitudinal Field Research on Change: Theory and Practice", *Organization Science*, 1 (3), 267-292.

Pettigrew, A. 1997. "What is a Processual Analysis?", *Scand. J. Mgmt*, 13 (4), 337-348.

Porter, M. and Millar, V. 1985. "How information gives you competitive advantage", *Harvard Business Review*, July-August, 149-160.

Posch, R. 1999. "Using Middleware for Interoperable Systems", In *Systems Integration Success,* Edited by Wyzalek J., Auerbach.

Prince, D. 1998. *Supporting SAP R/3. The Essential Guide to Supporting an SAP Business Environment*, Prisma Publishing.

Reich, B. and Benbasat, I. 1990. "An Empirical Investigation of Factors influencing the Success of Customer-Oriented Strategic Systems", *Information Systems Research*, 1 (3), 325-347.

Reinhard, N. and Bergamashi, S. 2001. "Management of ERP Systems Implementation in Brazil", *Proceedings of the Seventh Americas Conference on Information Systems.*

Rockart, J. and Short, J. 1989. "IT in the 1990's: Managing Organizational Interdependence", *Sloan Management Review*, Winter, 7-17.

Rodecker, R. and Hess, T. 2001. "User Satisfaction with ERP Systems: The Effect of User Knowledge and Involvement, Training, and Locus of Control", *Proceedings of the Seventh Americas Conference on Information Systems.*

Rogers, E. 1995. *Diffusion of Innovations*, The Free Press.

Rogers, E. and Shoemaker, F. 1971. *Communications of Innovations*, The Free Press.

Romeo, Jim. 2001. "Less pain, more gain in ERP rollouts", *Network Computing*, September 17, (http://www.networkcomputing.com/1219/1219f23.html)

Rosemann, M., Scott, J. and Watson, E. 2000. "Collaborative ERP Education:

Experiences from a First Pilot", *Proceedings of the Sixth Americas Conference on Information Systems.*

Rosemann, M., Sedera, W. and Gable, G. 2001. "Critical Success Factors of Process Modelling for Enterprise Systems", *Proceedings of the Seventh Americas Conference on Information Systems.*

Ross, J. 1999. "Dow Corning Corporation: Business Process and Information Technology", *Journal of Information Technology*, 14, 253-266.

Ross, J. 1999. "The ERP Revolution: Surviving vs. Thriving", *Working Paper*, Centre for Information Systems Research - MIT Sloan.

Rushton, A., Oxley, J., and Croucher, P. 2001. *Handbook of Logistics and Distribution Management*, 2nd Edition, Kogan Page Ltd.

Sanders, G. and Courtney, J. 1985. "A Field Study of Organizational Factors influencing DSS Success", *MIS Quarterly*, 9, 1, 77-93.

SAP. 2002. "Data Warehousing with MySAP Business Intelligence", *SAP White Papers*, (http://sap.com).

Sasovova, Z., Heng, M. and Newman, M. 2001. "Limits to Using ERP Systems", *Proceedings of the Seventh Americas Conference on Information Systems.*

Scheer, A. and Habermann, F. 2000. "Making ERP a Success", *Communications of the ACM*, 43 (4), 57-61.

Scott, J. and Kaindl, L. 2000. "Enhancing Functionality in an Enterprise Software Package", *Information and Management*, 37, 111-122.

Scott, J. 1999. "The FoxMeyer Drug's Bankruptcy: Was it a failure of ERP?", *Proceedings of the 5th Americas Conference on Information Systems.*

Senge, P., Kleiner, R., Ross, C., Roth, R. and Smyth, B. 1999. *The Dance of Change: The Challenges of Sustaining Momentum in Learning Organizations,* London: Nicholas Brealey Publishing.

Senge, P. 1994. *The Fifth Discipline: The Art and Practice of the Learning Organizations,* Currency-Doubleday.

Shanks, G., Parr, A., Hu, B., Corbitt, B., Thanasankit, T., and Seddon, P. 2000. "Differences in Critical Success Factors in ERP Systems Implementation in Australia and China: A Cultural Analysis", *Proceedings of Eighth European Conference on Information Systems*, Vienna, Austria.

Shepherd, J. 2001. "Enterprise Business Systems Must Be Upgraded and Maintained", *AMR Research - Executive View,* (http://www.amrresearch.com/ exv/default.asp?i=57)

Slater, D. 1999. "An ERP Package for You... and You... and You... and Even You", *CIO Magazine,* February 15, (http://www.cio.com/archive/021599_erp.html).

Smyth, R. 1999. "Understanding CASE Success: A Basis for Ongoing CASE Adoption", *Proceedings of the 7th European Conference on Information Systems.*

Smyth, R. 2001. "Challenges to Successful ERP Use", *Proceedings of the 9th European Conference on Information Systems.*

Soh, C. and Markus, M. 1995. "How IT Creates Business Value: A Process Theory Synthesis", *Proceedings of the Sixteenth International Conference on Information Systems.*

Soh, C., Siew Kien, S., Tay-Yap, J. 2000. "Cultural Fits and Misfits: Is ERP a Universal Solution?", *Communications of the ACM*, 43 (4), 47-51.

Soliman, F. and Youssef, M. 1998. "The Role of SAP Software in Business Process Reengineering", *International Journal of Operations and Production Management*, 18 (9/10), 886-895.

Sproot, D. 2000. "ERP: Componentizing The Enterprise Application Packages", *Communications of the ACM*, 43 (4), 63-69.

Stedman, C. 1999. "Firm focus on perfecting new ERP systems - work does not stop after installation", *Computerworld*, October 4, (http:// www.computerworld.com/news/1999/story/0,11280,37137,00.html)

Stefanou, C. 1999. "Supply Chain Management and Organizational Key Factors for Successful Implementation of ERP Systems", *Proceedings of the Fifth Americas Conference on Information Systems*, Milwaukee, USA.

Sullivan, B. 2002. "Baan rolls out new manufacturing management tool", *Computerworld*, June 11, (http://www.computerworld.com/ softwaretopics/crm/story/0,10801,71918,00.html).

Sullivan, C. H. 1985. "Systems Planning in The Information Age", *Sloan Management Review*, Winter, 3-12.

Summer, M. 1999. "Critical Success Factors in Enterprise Wide Information Management Systems Projects", *Proceedings of the Fifth Americas Conference on Information Systems*, Milwaukee, USA.

Swanson, E. B. 1994. "Information Systems Innovation Amongst Organizations", *Management Science*, 40 (9), 1069-1092.

Taylor, J. 1998. "Participative Design: Linking BPR and SAP with STS Approach", *Journal of Organizational Change Management*, 11 (3), 223-245.

Tornatzky, L. and Klein, R. 1982. "Innovation Characteristics and Innovation Adoption-Implementation: A Meta-Analysis of Findings", *IEEE Transactions on Engineering Management*, EM-29 (1), 28-45.

Tsang, E. and Kwan, K. 1999. "Replication and Theory Development in Organizational Science: A Critical Realist Perspective", *The Academy of Management Review* 24 (4), 759-780.

Tyre, M. and Orlikowski, W. 1994. "Windows of Opportunity: Temporal Patterns of Technological Adaptation in Organizations", *Organization Science*, 5(1), 98-117.

Van de Ven, A. 1986. "Central problems in the Management of Innovation", *Management Science*, 32 (5), 590-607.

Volkoff, O. and Sawyer, S. 2001. "ERP Implementation Teams, Consultants, and Information Sharing", *Proceedings of the Seventh Americas Conference on Information Systems*.

Voss, C. A. 1994. "Implementation of Manufacturing Innovations", In *The Handbook of Industrial Innovation*, Edited by Dodgson, M. and Rothwell, R., Edward Elgar.

Westerman, G. and Cotteleer, M. 1999. "Tektronix, Inc: Global ERP Implementation", Case 9-699-043, Boston: Harvard Business School Publishing.

Whang, S., Gilland, W. and Lee, H. 1995. "Information Flows in Manufacturing under SAP R/3", Case Study No. OIT – 13, Stanford University Graduate School of Business.

Willcocks, L. and Sykes, R. 2000. "The Role of the CIO and IT Function in ERP" *Communications of the ACM*, 43 (4): 32-38.

Winston, E. and Dologite, D. 1999. "Achieving IT Infusion: A Conceptual Model for Small Businesses", *Information Resources Management Journal*, Jan-Mar, 26-38.

Wolcott, H. 1982. "Differing Styles of On-Site Research, or, If it is not ethnography, what is it?", *The Review Journal of Philosophy and Social Science*, 7 (1 and 2), 154-169.

Wolfe, R. 1994. "Organizational Innovation: Review, Critique and Suggested Research Directions", *Journal of Management Studies*, 31 (3).

Woods, P. 1999. *Successful Writing for Qualitative Researchers*, London: Routledge.

Worthen, B. 2002. "Nestle's ERP Odyssey", *CIO Magazine*, May 15, (http://www.cio.com/archive/051502/nestle.html).

Yin, R. 1994. *Case Study Research. Design and Methods*, USA: Sage Publications.

Yusuf, Y. and Little, D. 1998. "An Empirical Investigation of Enterprise-Wide Integration of MRP II", *International Journal of Operations and Production Management*, 18 (1), 66-86.

Zmud, R. and Apple, A. 1989. "Measuring Information Technology Infusion", *unpublished manuscript*.

Zuboff, S. 1988. In the Age of the Smart Machine: The Future of Work and Power. New York: Basic Books.

APPENDIX 1: Major ES Vendors

A number of authors and research firms seem to agree that the top-five ES vendors are SAP, Baan, Peoplesoft, Oracle Corp., and JD Edwards & Co. (Davenport 2000; Romeo 2001). According to Advanced Manufacturing Research (AMR), these five vendors account for sixty four percent of the ES market revenue. The aim of this appendix is to do a brief description of these five vendors and their ES software. The information has been taken from the vendors' web-pages and from stories narrated by third authors such as Hibbert (2001), Parker (1996), Davenport (2000), Prince (1998), Konicki (2000), Olson and Disabatino (2000), and Greenberg (1995).

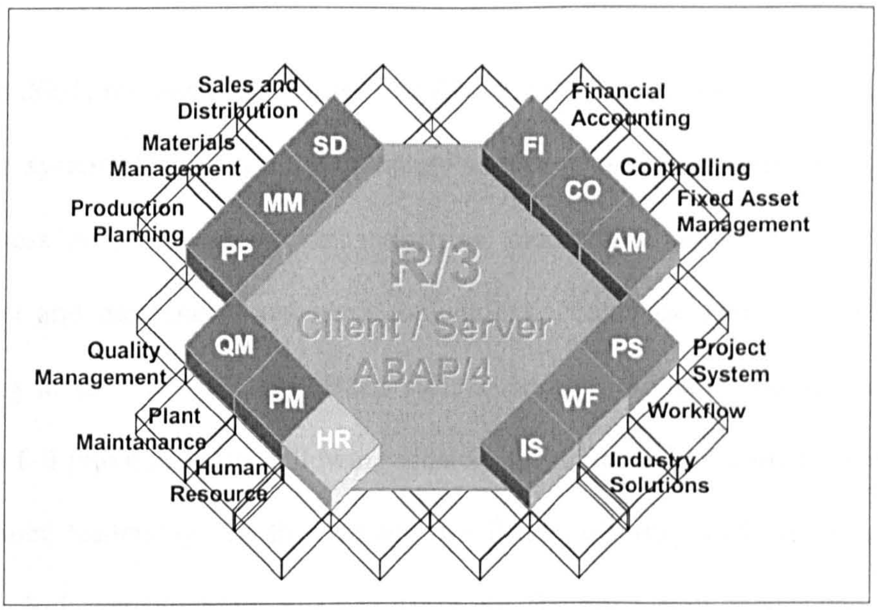
SAP

SAP (Systems, Applications, Products in Data Processing) is recognized as the fourth-largest independent software supplier worldwide. SAP born in 1972 when five former IBM systems analysts began working on the idea for a cross-functional information system. Its first ERP system was released in 1979. This was called as the R/2 system, which ran on mainframe architectures. In 1992, the R/3 system was introduced. R/3 is the client-server version of the system. Figure A.1 illustrates the standard R/3 components.

In 1999, SAP released mySAP.com, which represents the SAP's new Internet strategy. MySAP.com delivers a comprehensive e-business platform, which covers the entire range of SAP solutions. MySAP.com solutions encompass: industry solutions, solutions for small and midsize businesses, enterprise portal, supply chain management, customer relationship management, supplier relationship management, product lifecycle management, marketplace, business intelligence, financials, human resources, mobile business, and technology.

Nowadays, SAP has its headquarters in the town of Walldorf, Germany. SAP has more than 17.000 customers worldwide and almost a 30 percent share of the ES market. The SAP's ES is considered as the most extensive ES in the market. Because of this, its implementation may be more complex than implementing ES from other providers.

Figure A.1 The Standard R/3 Components



Source: Prince (1998).

Baan

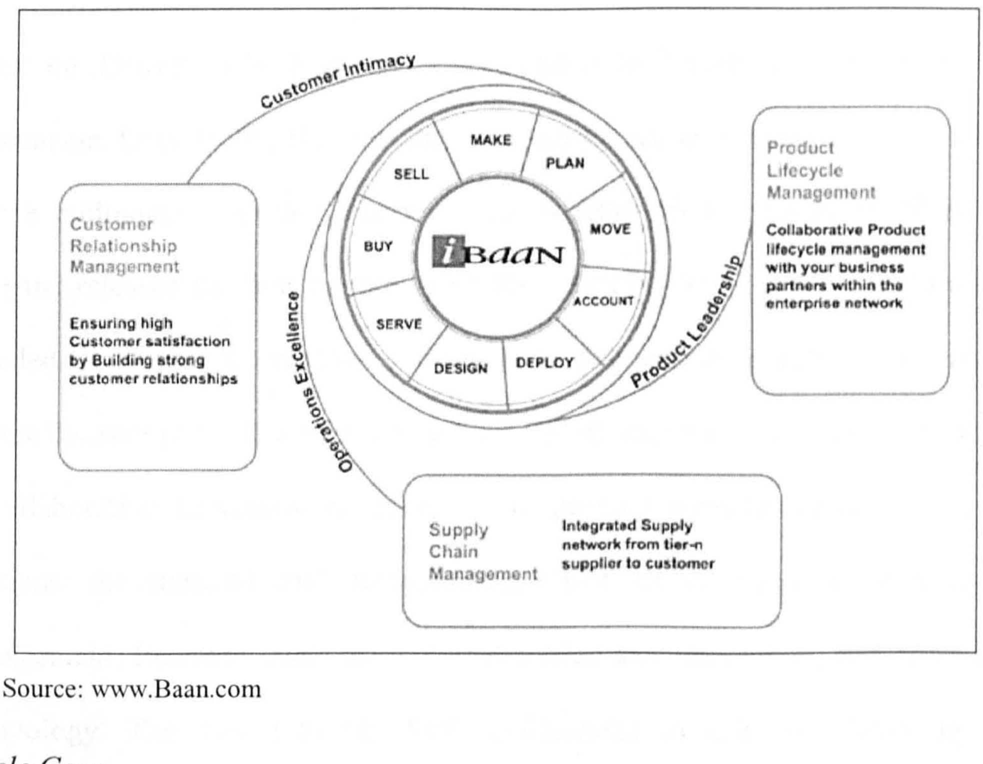
Baan was founded in 1978 in the Netherlands by Jan and Paul Baan. They are considered amongst the most successful Dutch businessman of the nineties. The Baan's traditional strength has been to develop software for the manufacturing industry, counting Boeing, Ford, and Philips amongst its industrial clients. Over the nineties, two versions of the Baan's ES were introduced in the market: Triton and Baan IV. Triton was a suite of 37 manufacturing application modules offering distribution, accounting, and engineering data management capabilities. Baan IV included new functionality for supply chain management, enhancements to the desktop environment, and Internet capabilities. The company began running some financial difficulties since 1999. It reported losses of $309.6 million for 1999 and shares declined to $1.12 for 2000. In July 2000, Invensys – the world's largest makers of control and industrial automation equipment based in London – took control of Baan. Nowadays, Baan is part of the Invensys' Software and System Division.

In 2001, Invensys had released its iBaan suite, which is an Internet-enabled enterprise system. Nowadays, the company's strategy has been addressed to meet the business processes of six key industries: electronics, automotive, industrial equipment and machinery, aerospace and defence, logistics, and manufacturing. According to the provider, the iBaan suite supports companies whose business strategies fall into one of the following: customer intimacy, operational excellence, and product leadership. In this sense, the iBaan offering includes iBaan for Customer Relationship Management, IBaan for Supply Chain Management, and iBaan for Product Lifecycle Management (see Figure A.2).

Peoplesoft

Based in California, Peoplesoft was founded in 1987 when its founders created a human-resources application on a client-server platform instead of mainframes. Today, Peoplesoft is considered the leader in the Human Resource market. In 1995, the company released a number of applications which extent its business scope. These applications included: student administration system for higher education, manufacturing applications, and applications for specific industry markets such as healthcare, federal government, and financial services. In 2000, the company announced Peoplesoft 8, which represented a shift to the Internet. Today, the Peoplesoft's software includes: industry solutions, solutions for education and government, solutions for small and mid-sized organizations, customer relationship management, enterprise performance management, enterprise service automation, financial management solutions, human capital management, human resources management, supplier relationship management, and supply chain management.

Figure A.2 The iBaan solutions to meet different business strategies



Source: www.Baan.com

Oracle Corp

Oracle Corp. was founded in 1977 as a database company. Oracle is considered one of the strongest competitors in the database market. Its database offering is one of the most used by companies for storing the ES data. By the late 1980s, Oracle began to develop its own computing applications. Some specific offerings have been co-developed with customer companies or have been acquired from customer companies (e.g. the Energy Downstream Application obtained from BP). The latest version of the Oracle's ES – Oracle E-business Suite – encompasses the following functionality: advanced planning, e-commerce, financials, manufacturing, procurement, projects, training, business intelligence, enterprise asset management, human resources, marketing, product development, sales, treasury, oracle small business suite, contracts, exchanges, interaction centre, order fulfilment, professional services automation, and service.

J.D. Edwards & Co.

Based on Denver, J.D. Edwards was founded in March 1977 by three ex-accountants. Over 1980s, the company was recognized as a leader of applications for the midrange-computing platform such as IBM AS/400 series. In 1996, the company released the first version of its ES – OneWorld. In 2000, J.D. Edwards unveiled OneWorld Xe to allow companies to enable collaboration with partners outside the enterprise. The latest company's ES offering was called J.D. Edwards 5 – Collaborative Enterprise Solutions. This product includes seven groups of solutions: the standard ERP functionality, CRM, SCM, Supplier Relationship Management, Business Intelligence, Collaboration and Integration, and Tools and Technology. The J.D. Edwards ERP applications include the following six categories of modules: Enterprise Foundation (Financial Management, Technical Foundation); Assets (Inventory Management, Enterprise Asset Management, Real Estate Management, Advanced Real Estate Forecasting); People (Workforce

Management, Time and Expense Management); Projects (Project Management, Homebuilder Management); Suppliers (Procurement, Subcontract Management); Fulfilment (Order Management, Manufacturing Management).

APPENDIX 2: Brief Chronology of the ES Implementation in UC.

Time	Events
1995	• The IT management suggested the use of a client-server architecture, instead of the existing mainframe architecture. • The first objective was the development of systems for the finance, human resources and operations areas. • The company had already known that its systems did not recognize the year 2000.
1996	• A local consultancy was contracted to reengineer the financial processes. One of the results of this work was to suggest the acquisition of an ES for this business area. In particular, the acquisition of the financial accounting functionality. • The finance and IT areas had serious conflicts of power. • The finance area decided to buy the ES suggested by consultants. • The project team was composed of employees from the finance area.
1997	• This first attempt of implementation was cancelled on December 1997 because of many problems. • The CEO was changed and the finance manager also left the company. • The local consultancy was acquired by a multinational firm.
1998 (1st half).	• Everybody was wondering what to do with the system. The decision was to go on with the project. • The work of the local consultancy was unsatisfactory and UC decided to contract a new consultancy. • The new consultancy was selected because of its experience in the ES implementation in public companies.
1998 (2nd half).	• The second attempt of implementation began on July. They began with the implementation of the financial accounting functionality (FI). • The company recruited a functional leader who was experienced in the ES implementation. • The project team was composed of people with poor skills. • The functional leader assumed full responsibility. • The functional leader and the consultants carried out everything in the project. • The company began with the implementation of the materials management functionality (MM). • An additional project team was formed for the implementation of the

Time	Events
	MM functionality
	• The MM project team was composed of five people. They had an excellent knowledge of their area.
1999	• The CEO and the upper-management were again changed.
	• The financial accounting functionality went live on January (six months after the beginning, as planned).
	• The MM functionality went live on May (also as planned).
	• The FI leader and the project manager left the company.
	• The new management proposed a centralized business model, which was opposite to that configured in the system.
	• The IT manager presented a diagnostic document to the new management.
	• A Help Desk centre was designed.
2000	• In the first semester, the company solved a number of post-implementation problems.
	• Training was planned for improving the user's technical skills.
	• The third phase of the ES experience would consist of adjusting the system to the new business model. System re-configuration and training were planned.
	• The fourth phase would be the implementation of new functionality.

APPENDIX 3: INTERVIEW PROTOCOL (Second Round)

Use of the System

1. Do you use the ES to automate tasks and/or to enhance control over business processes, and/or to standardize business processes?
2. Do you use the ES to make/explain decisions?
3. Do you use the ES to exchange information and coordinate activities between business areas?
4. Do you use the ES to monitor your own performance, to monitor your business area's performance, and/or to plan your own work?
5. Do you use the ES to improve customer service (both internal and external clients), or to understand clients' needs, or to exchange information with your clients?
6. Do you use the ES to automate process management by using sophisticated algorithms (e.g. MRP, DRP)?

Human issues

1. Which have your perceptions been of the ES? Is the ES useful? Is the ES friendly? How have these perceptions evolved?
2. Have these perceptions affected your attitude to use the ES?
3. Have some event-activity-actor affected your attitude to use the ES?
4. Do you have a positive attitude to use the ES? Why?

Processual issues

1. Do you think that end-user training influence the use of ES? How?

2. Do you think that ES configuration influence the way as the ES is used? Do the ES have to be tailored to enhance its use? How? Do you have any example?

3. Do you think that knowledge transfer from consultants to users influence the use of the ES? How?

4. Do you think that organizational adaptation (e.g. change of roles, process redesign) is a major issue in the implementation of an ES?

Contextual Issues

1. Do you think that issues related to organizational structure (e.g. norms and procedures, centralization vs. decentralization, authority and control) influence the use of ES? How?

2. Do you think that power relations between business areas influence the use of ES? How?

3. Do you think that project budget influence the use of ES? How?

4. Do you think that user skills influence the use of ES? How?

5. Do you think that the management, technical, and functional support influence the use of ES? How?

Closure questions

1. What of all of these variables discussed above are the three most important variables influencing the ES-use?

2. What further variables do you add to those discussed above?

APPENDIX 4: INTERVIEW PROTOCOL (Third Round)

Use of the System

1. Do you use the ES to automate tasks and/or to enhance control over business processes, and/or to standardize business processes?
2. Do you use the ES to make/explain decisions?
3. Do you use the ES to exchange information and coordinate activities between business areas?
4. Do you use the ES to monitor your own performance, to monitor your business area's performance, or to plan your own work?
5. Do you use the ES to improve customer service (both internal and external clients), or to understand the clients' needs, or to exchange information with your clients?
6. Do you use the ES to automate process management by using sophisticated algorithms (e.g. MRP, DRP)?

Infusion

1. Can these uses be achieved all together at the same time? Or do these uses evolve over time?
2. What uses are the easiest to achieve and what not? Why?
3. Have these uses been easier to achieve in one area rather than in others? Why?

Diffusion Model

1. How was the diffusion model developed by the company? What was first, second, etc? Why?

2. What are the major activities or phases of the implementation and diffusion process? Topics to be covered: implementation strategy, selection of functionality, process modelling, system configuration and tailoring, organizational adaptation, end-user training, and rollout.

3. How is the system functionality selected? Can some further system functionality be activated and implemented as a result of the use of the system?

4. What operational knowledge has to be learnt by users in order to use the system extensively? Why?

5. What conceptual knowledge has to be learnt by users in order to use the system extensively? Why?

6. Could you explain any example in which the use of the system helped in better understanding of the system concepts and functionality? In these cases, were improvements and adjustments carried out on the early systems definitions and organizational models?

7. How does knowledge creation evolve over time?