Communications of the Association for Information Systems

Volume 15 Article 34

April 2005

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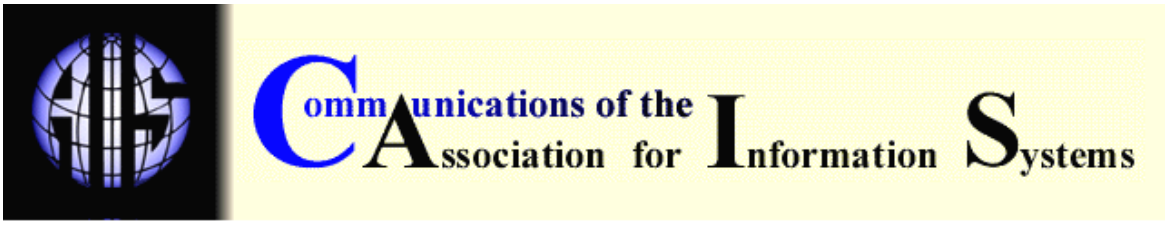

EMBEDDING THE ENTERPRISE SYSTEM INTO THE ENTERPRISE: A MODEL OF CORPORATE DIFFUSION

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ABSTRACT

The implementation literature shows that many organizations are able to install enterprise systems (ES), in the sense that they make the system available for use, but fail in their efforts to diffuse and incorporate the system throughout the organization's daily practices. This difficulty is not new. It is never the special characteristics of ES re-motivate an enquiry into issues of technological diffusion and the related areas of learning. This research identifies and describes the process and key actions associated with the diffusion of ES. The presentation focuses on two key case studies. The methodology utilizes in-depth case studies for constructing theory from the observed field data. The ES diffusion model presented puts use amidst a network of knowledge flows and learning episodes. This new perspective puts more emphasis on the importance of experiential learning than some accounts and reaffirms the vital role of knowledge creation and sharing. The studies also show how the diffusion of ES throughout the organizations was an iterative, cumulative, and virtuous process over time. Finally, the studies confirm that it is the different dimensions of business adaptation and system configuration and tailoring, that represent the authentic signature of the ES implementation experience.

Keywords: enterprise systems, diffusion, learning and knowledge creation.

I. INTRODUCTION

The enterprise system (ES) is widely and frequently heralded as a departure in the short history of modern IS. Interest in ES arises from its scale (offering pan-functional support to the business) and constitution (it is a standard system that is configured and modified by the adopting company). Over the past decade, these systems were implemented by thousands of companies all over the world. Controversy followed in their wake. An ES literature developed reporting the

problematic character of its implementation [Bancroft, 1998; Gibson et. al., 1999; Markus et al., 2000; Markus and Tanis, 2000], failure cases [Lorenzo, 1998a; Scott, 1999; Buckout, 1999], its relationship to business strategy [Davenport, 1998; Holland and Light, 1999; Davenport, 2000] and other issues. The implementation literature shows that many organizations were able to install ES, in the sense that the system is available for use, but failed in their efforts to diffuse and incorporate it throughout the organization's daily practices [Gilbert, 1999; Stedman, 1999; James and Wolf, 2000; Smyth, 2001]. This difficulty with embedding technology into organizational processes and culture is not new. It is, of course, widely documented in the implementation of many other kinds of information systems [Kwon and Zmud, 1987; Cooper and Zmud, 1990]. However, the special characteristics of ES re-motivate an enquiry into this topic. Given its sheer scale and its standardized functionality, the processes of adoption and diffusion might be quite distinctive. Hence this paper revisits key IS themes – the innovation and diffusion of IS – but in the changed context of ES.

II. LITERATURE REVIEW

THE ENTERPRISE SYSTEM

Briefly, ES (also known as ERP systems) "enable the integration of transactions-oriented data and business processes throughout an organization" [Markus and Tanis, 2000: p.4]. 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 existing or proposed ways of working. Instead, much greater emphasis is placed on the organization adapting its business processes to the package's generic functionality. Typically this adaptation will involve the reworking of business processes through some degree of business process redesign [Markus and 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 are recorded [Markus and Tanis, 2000]. It follows that business process redesign and software configuration are key spheres of activity in any ES project.

A third key area emerges in that an ES project may also take on many of the characteristics of a conventional software development project [Brehm et. al., 2000]. New functionality may be coded into the system or existing modules may be rewritten. Coding thus becomes a further key sphere of activity for many ES projects. It is potentially the most complex and costly area of activity, and is associated with an increased likelihood of failure [Parr et al., 1999; Kawalek and Wood-Harper, 2002].

Once the system is set in place, the effort shifts to continuous process improvement and fine-tuning of the software [Couillard et. al., 1999; James and Wolf, 2000; Markus and Tanis, 2000]. Throughout this process, as in the implementation phases, the project is characterized by the involvement of a large number of stakeholders [Soh et. al., 2000], the assimilation of a large amount of knowledge [Couillard et. al., 1999; Soh et. al, 2000] and the development of additional user skills [Markus and Tanis, 2000].

In the study of ES, a spectrum of results and experiences are reported throughout the life cycle. Much research on ES was undertaken to understand the implementation problems in project phases and to learn which factors encourage success. Such factors research generated a set of issues that appear to be related to ES success and failure. For example,

- business vision [Davenport, 1998; Holland and Light, 1999],
- management support [Holland and Light, 1999; Parr et al., 1999],

- the organization of the project team [Bancroft, 1998; Parr et al., 1999; Newell et al., 2001],
- minimal customization [Bancroft, 1998; Parr et al., 1999; Brehm et al., 2000], and
- communication and training [Bancroft, 1998].

Other works focused on the how to measure success in each phase of the life cycle. Markus and her colleagues [Markus et al., 2000; Markus and Tanis, 2000] modeled the ES experience and the dynamics of ES success through the Enterprise Systems Experience Cycle. Following emergent process theories [Orlikowski and Robey, 1991; Soh and Markus, 1995], 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.

THE TECHNOLOGICAL DIFFUSION PERSPECTIVE

This paper adds to this work by looking at ES implementation as an effort in technological diffusion within a user community. This broader perspective on ES implementation relates to the earlier body of IS research [Kwon and Zmud, 1987; Cooper and Zmud, 1990]. The diffusion perspective allows integrating of long-term requirements and challenges (e.g., continuous improvement and learning) into the study scope. Different authors identify differing stages in the diffusion of a technological innovation, but all of them seem to agree that the process finishes when the use of the technology is encouraged as a normal activity - i.e., routinizing or infusion [Kimberly, 1981; Coopers and Zmud, 1990; Rogers, 1995]. For Kimberly [1981], the theoretical issue underpinning this perspective is understanding why and how an innovation spreads inside an organization, that is its process of internal diffusion beyond the installation project.

In addition, the technological innovation perspective also considers long-term requirements and challenges that must be faced by organizations when introducing an innovation. For example, Rogers [1995] talks about the clarifying stage. That is, arrangements and corrective actions that are made for the innovation to eliminate misunderstanding or unwanted side-effects that originate in the initial stages. This problem-solving process is described by other authors as a vital part of the innovation process [Argyris, 1992; Leonard-Barton, 1995]. Making corrective actions to the innovation relies on a cycle of action-outcome-feedback carried out by various individuals in the organization. By looking into these social processes of problem solving and learning, and by extending study of the implementation process in this diffusion perspective, organizations are more likely to reap lasting benefits [Leonard-Barton, 1995].

The issue of learning, thus introduced, features widely in studies of technological diffusion. In the early work of Kwon and Zmud [1987] information systems implementation can be defined as an organization effort to diffuse an appropriate IT within a user community. This approach helps to set the issue of learning clearly in the center of the debate. It relates to the wider discourse on organizational learning which is studied as a means of appreciating the developmental behavior associated with many different aspects of organizational life [e.g., Ciborra and Andreu, 1998; Senge et al., 1999]. 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. As Kolb [1984] states, “learning is the process whereby knowledge is created through the transformation of experience” (p. 38). This definition encompasses two parts: (1) knowledge creation and (2) transformation of experience as a process. Argyris [1982, p. 8] 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” [Argyris, 1992: p.8].

A number of papers applied the ‘learning perspective’ in the context of IS [e.g., Kwon and Zmud, 1987; Attewell, 1992; Swanson, 1994; Allen, 2000]. With respect to ES research, knowledge creation in an ERP project team [Newell et al., 2001] and the knowledge transfer from consultants

to users [Jones, 2001], developed more recently. Less attention has been given to ES implementation and diffusion as learning and knowledge creation processes.

Thus, the special characteristics of ES explained above re-motivate an enquiry into issues of technological diffusion and the related learning. Given its sheer scale and its standardized functionality, the processes of diffusion and infusion might be quite distinctive. This perspective enables a broader perspective on ES implementation, adding to the research cited earlier and holding the promise of a richer understanding of ES.

III. RESEARCH METHODOLOGY

This research sets out to achieve the following aims:

- To model the diffusion process for ES;
- To recount the characteristics of ES projects through the model;
- To reflect critically upon the validity of the model and its development;
- To reflect critically on the nature of the ES diffusion processes.

A debate exists about how much shape a qualitative research design, such as theory generation from case study evidence, should have. Many schools of thought (e.g., amongst much anthropology and other phenomenological study) consider that social processes cannot be approached with explicit conceptual frameworks or standard instruments. They prefer loose, structured approaches to gathering data. For these positions, the conceptual framework emerges from the field in the course of the study and the important research questions are recognised only gradually [Miles and Huberman, 1994]. Some other authors take a contrary position. Wolcott [1982] argues that "it is impossible to embark upon an investigation without some idea of what one is looking for." This stream suggests tighter designs: pre-existent conceptual frameworks, a set of research questions, and predesigned instruments for collecting data. The stance taken in this research lies between the two positions: a definition of primary purposes, constructs and questions, but allowing an open-ended process of inductive exploration and pattern recognition. This position is similar to that of Pettigrew [1997], which is characterized in terms of cycles of deduction and induction. The reason for adopting this stance is that, although ES literature is extensive, few works consider the new situated issues related to ES diffusion, learning, and infusion, and how their related processes occur.

The research presented here sought to identify and describe the process and key actions associated with the diffusion of ES. The methodology uses in-depth case studies for constructing theory from the observed field data [Glaser and Strauss, 1967; Walsham, 1995; Miles and Huberman, 1994]. This presentation focuses upon two of three key case studies. The main pre-condition for each site was to ensure that the ES had already been available to use in these sites (i.e., it had been acquired and installed, in at least one business unit for at least one year).

The process and key actions of diffusion were investigated 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.

In the Coffee Company (CC), the first case study, 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 1 shows the role breakdown of the different interviewees. The lead 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, user manuals, procedures, system manuals, and reports of earlier phases in the ES implementation.

Table 1. Interviewee 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**

In the second case, Engineering Services Company (ESC) twenty-three semi-structured interviews were conducted (Table 2). Each lasted an average of one and half hours. A documentary review focused on memos, users manual, procedures, system manuals, and reports of early implementation phases. The lead researcher also participated as observer in three project meetings.

In the Chemical Products Company (CPC), the third site, seventeen semi-structured interviews were conducted, each lasting an average of one and half hours. 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. IT planning,
3. the definition and design of business models, and
4. the definition of the system's tailoring options.

Table 2: Position and Number of Interviews Conducted at ESC

Interviewee Position	AMOUNT
Upper-Management	
President (CEO)	1
Finance Vice President (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**

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

This process allowed an initial formulation of the model to be created after commencing the study of the first site, and for the model to be presented to the interviewees at that site. They were invited to comment on it and to recount the experience of their projects by making reference to it. This procedure led to its enhancement and refinement before it was presented to the interviewees at the second-case study site. Here again, enhancements and refinements were made which were presented back to key individuals at the first site. The third site followed. Throughout this process of development and refinement, a generic model was sought. There were differences between the study sites but users were encouraged to agree on a generic solution that sufficiently articulated the dynamics of their projects.

The data analysis consisted of three iterative activities:

- data reduction,
- data display. and
- conclusions drawing/verification [Miles and Huberman, 1994].
-

The iteration process ended when the analysis reached 'theoretical saturation' [Glaser and Strauss, 1967]. The study used ATLAS/ti software[1] for some steps of the data analysis, such as coding, search, and retrieval, and building concepts.

IV. THE ES DIFFUSION MODEL

The ES diffusion model thus was developed over three cases. It is shown diagrammatically at Figure 1. It represents the key processes involved in ES diffusion and identifies the learning

[1] See http://www.atlasti.de/ (in German) or search Google for ATLAS/TI SOFTWARE

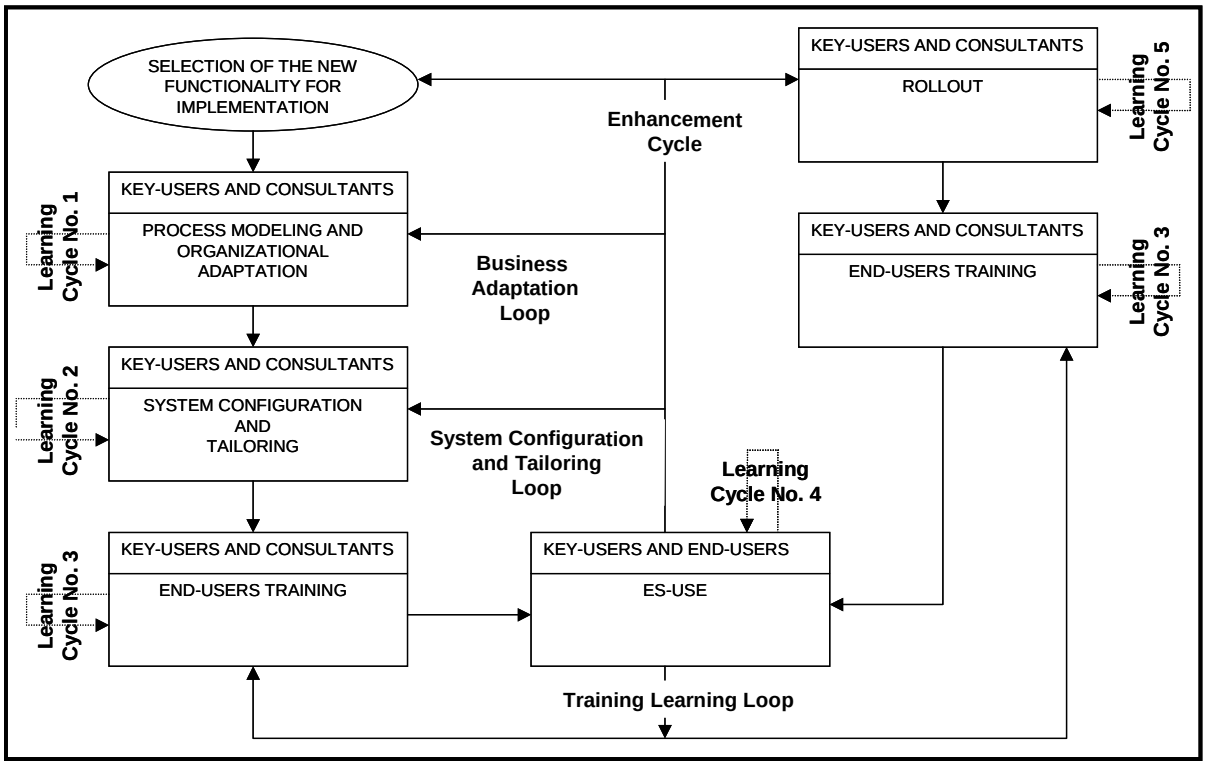

Figure 1. The Model of the Diffusion of the ES

categories associated with them. The symbols and language are designed to aid the reader to understand the model. Four symbols (shapes and lines) are used:

- The elliptical shape represents the trigger of the implementation process. It defines a set of functions to be implemented. The trigger will fire several times over the lifetime of an ES.
- The quadrilateral shapes (boxes) represent the activities carried out in the diffusion process. They also encompass: (1) roles in charge of each activity (e.g., key users, end users, and/or consultants) and (2) learning cycles associated with each activity. These cycles are drawn as loops next to each box.
- The lines without labels (i.e., without a particular name that identifies them) represent the sequence of the activities ending in the use of the system.
- The labeled lines represent the four feedback loops from the ES-use box (i.e., enhancement cycle, business adaptation loop, system configuration and tailoring, training learning loop).

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

The first logical activity is then Process Modeling and Organizational Adaptation. Process Modeling is used as an instrument to help to decrease the gap between the ES and the organization's needs [Rosemann et al., 2001]. Organizational Adaptation occurs to follow the modeled process. For example, adaptation could imply changes in roles, procedures, sequence of tasks, and organizational structure [Davenport, 1998; Lorenzo, 1998b; Brehm et al., 2000]. This first activity is carried out jointly by key users such as those shown in Tables 1 and 2 and consultants. These two roles face the important responsibility of leading decisions about how the organization's processes are to be mapped and adapted [Volkoff and Sawyer, 2001]. Key users provide business knowledge whilst consultants provide product knowledge [Soh et al., 2000].

Associated with this activity is Learning Cycle No. 1. The initial knowledge acquired by key users is the action, or know-how, of modeling business processes. Rosemann and his colleagues [2001] consider that the modelers need to know about modeling methodology, modeling language, and a modeling tool. More broadly, to do modeling effectively, it is necessary to understand organizational needs, ES business practices, and the ES integration philosophy clearly. Once process modeling and organizational adaptation occurs, System Configuration and Tailoring takes place. As mentioned previously, configuration refers to setting parameters in the package to support organizational procedures and processes. Tailoring the ES refers to adaptations that go beyond parameter setting[2]. It encompasses activities such as additional programming and implementing 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 day-to-day operations is End-user Training. This activity is also shown as the responsibility of both key-users and end-users. The recorded practice suggests that key-users are given the responsibility for carrying out this activity but that they are first trained by ES consultants. This activity of training the trainers is reported 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, of course,the major goal of the ES implementation. However, it should be understood that the dynamic relations between the diffusion activities are not linear, and are more complex than a simple precedence connection. Although some authors place system use after implementation [Bancroft, 1998], ES-use here is better understood as part of ES implementation. ES-use is the trigger of the main experiential learning processes that further encourages the diffusion process (i.e., the four feedback loops in Figure 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, dealing with data can be complex. This complexity might necessitate different learning strategies by the users. Learning cycle No. 4 acts as experiential learning. However, when 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 [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 modeled

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

processes and the actual processes. On the other hand, if a mismatch occurs between the modeled and actual processes, organizational learning activities seek to move towards a final version. This kind of mismatch can be the result of 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 gained some experience using the system.

The presence of any kind of mismatch between the actual and modeled 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 Process Modeling and Organizational Adaptation activity and the System Configuration and Tailoring activity. In other words, they seek to adapt the organizational processes or the system functionality.

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

- Implement new ES functionalities on additional business functions or processes which implies iteration of the cycle of Process Modeling and Organizational Adaptation, System Configuration and Tailoring, End-users Training, and ES-use;
- Rollout a particular ES function already implemented in some part of the corporation into additional business units or dependencies. Rollout is thus the ongoing and further release of designated functionality into the business units [Couillard et al., 1999; Markus and Tanis, 2000]. The knowledge to be acquired here by key users is the know-how of rollout methods (e.g., iterative configuration of similar warehouses). This knowledge is gained under Learning Cycle No. 5.

Such ES enhancements might be pre-planned or might arise out of organizational learning as the system is in use. For instance, the case evidence (Section V) shows that when the companies under study felt they satisfied their original needs and objectives, new objectives and ideas emerged. Thus the ES diffusion follows an iterative and virtuous process.

V. CASE DISCUSSIONS

In this section, the concepts in the ES Diffusion Model are discussed by detailed reference to the first of the three field studies. This discussion describes their derivation and validation, and the detail of the ES projects that took place. The material is detailed and rich, redolent of the practices and difficulties encountered in these major ES projects. As such, it serves to inform discussion of the value of the model, its value in identifying and classifying project phenomena, and allows the debate to move outwards to the nature of ES projects themselves. The presentation is then extended by an exposition of the second of the three sites. This shorter presentation is intended to exemplify the generic nature of the model. The requirement of brevity prevents a longer presentation of this second site although all three studies are described in depth in [Lorenzo, 2003]. Tables 3, 4 and 5, shown at the beginning of each case, describe the major events related to the activities and cycles of the diffusion process in the CC, ESC and CPC sites, respectively.

THE COFFEE COMPANY (CC)

Founded in 1958, Coffee Company (CC) is a nationally leading company in the processing and distribution of roasted and ground coffee in a South American country. Since 1992 it exported green coffee to the USA and Europe. In 2001, it earned $45 million in revenues and employed 370 people. Coffee is roasted, ground. and packaged in the company's modern processing plant. CC's procurement centers are 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 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's sales force of 35 people is responsible for selling to more than 700 big retail destinations (e.g., supermarkets and chains).

Table 3 shows the diffusion process in CC for 1997 through 2002.. It includes events by chronological time periods and activities-loops.

Selection of the New Functionality for Implementation

CC's ES project took place in three distinct waves. The first project began with the implementation of the functionality of financial accounting as a central repository of all transactions (e.g. accounts payable, accounts receivable, and general ledger) and, slightly later, with outbound and inbound logistics (i.e., materials management, distribution and sales). A second wave addressed the functionality of manufacturing and service operations. In a third wave, in 2002, CC planned to implement a set of new functionalities such as transport operations, B2B, executive information system, and assets management. This third wave is beyond the scope of this study.

Process Modeling and Organizational Adaptation

Once the functionality was chosen for implementation, CC set in motion the activity of Process Modeling and Organizational Adaptation. One example of effective modeling of processes was carried out for the distribution and sales process. In CC a clear understanding of the distribution and sales model was developed within the Learning Cycle No. 1. CC took more than a year to design this new distribution and sales business model. This process considered both organizational needs and ES business practices. Organizational needs that emerged were to:

- automate credit policies to control sales to intermediaries in order to encourage company growth in a secure way;
- control the intermediaries' sales to final clients; and
- 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.,

> *"The system allowed us to know and understand new business practices, which guided us in changing the way of operating our business".* A CC manager

Organizational adaptation occurs concurrently with, and by mutual reference to these modeling 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 centers can now finalize accounts receivable transactions in the system, allowing them to process a new sale immediately. To do so necessitated role changes for these sales assistants.

> *"It was necessary to enlarge functional skills related to sales administration of the sales centers' managers and assistants; …in some cases we got to recruit new personnel"*. A CC Manager

Table 3**.** 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 functionality of Financial Accounting in the Factory The functionality of Manufacturing in the factory	The functionality of Materials Management in the factory	The functionality of Service in the Factory for IT service orders	The functionality of Distribution & Sales (D&S) in just one of the remote D&S centers (Pilot)	
	Rollout of functionalities already implemented			The functionality of Financial Accounting & Materials Management in the remote procurement centers		The functionality of Distribution & Sales in the rest of 11 remote D&S centers
Process Modeling & Org. Adaptation	As part of the sequence of activities	Modeling of the financial process Modeling the manufacturing process	Modeling the process of procurement & warehousing related to the functionality of Materials Management	Modeling the service process related to IT service orders	Modeling the distribution & sales process - Role changes: e.g., sales assistants	
	As part of the business adaptation loop			Re-modeling the cost accounting system. Role changes in the production area's users.		
System Configuration & Tailoring	As part of the sequenceof activities	Configuring the functionalities of Financial Accounting and Manufacturing Developing an interface between the ES and the legacy sales application.	Configuring the functionality of Materials Management	Configuring the functionality of Service Development of reporting options to meet the IT department's requirements	Configuring the functionality of D&S 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 departments' 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

		1997-1998	1999 (1st half)	1999 (2nd half)	2000 (1st half)	2000 (2nd half)
End-users training	As part of the sequence of activities	Operational training (i.e., how to operate the system) of the functionality of Financial Accounting for the finance department's end-users	Operational training of the functionality of Materials Management for the procurement areas' end-users	Operational training of the functionality of Service for all end-users.	Operational training of the functionality of D&S for the remote D&S centers' end-users Conceptual training of the ES integration philosophy for the remote D&S centers' end-users	Operational training of the functionality of D&S for the remote D&S center's end-users Conceptual training of the ES integration philosophy for the D&S centers' end-users
	As part of the training loop			Conceptual training of the ES integration philosophy to end-users already trained		

		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 centers. This application is from a third provider.	The functionality of Distribution Requirements Planning (DRP)	Application for the definition and monitoring of the company's sales budget. This was a development by the IT department.	Plan: Functionalities and Applications to implement and/or develop over the next two years: Transport Operations, Executive Information System, B2B with clients, Statistical Inventory Control, Assets Management, ABC Costing, and localizations.
	Rollout of functionalities already implemented	The functionality of Distribution & Sales in the rest of 11 remote D&S centers	The Hand-Held Computers application (sales automation) in the rest of 11 remote D&S centers	The functionality of Service in all remote facilities for registering and monitoring the IT service orders	Plan: The functionality of Service in all remote facilities for registering and monitoring the IT service orders
Process Modeling & Org. Adaptation	As part of the sequence of activities	Designing Sales Bonus Scheme (as part of the functionality of D&S)	Designing the model of DRP to be used	Designing the model of sales budget to be used	Plan: Designing the model 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	Remodeling the process of procurement of indirect materials	Creating new procedures for helping in the auditing function. For instance, developing a report for auditing the bills of sales issued vs. the actual bills	Remodeling the process of procurement of direct materials

		2001 (1st half)	2001 (2nd half)	2002 (1st half)	2002 (2nd half)
System Configuration & Tailoring	As part of the sequence of activities	Development of an interface between the ES and the HHC application	Configuring the functionality of DRP 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 functionality of DRP Programming add-ons for calculating and reporting the sales bonus scheme	Programming an application for the company's sales budget using Excel & Visual Basic – Development of an interface with the ES using OLE automation Development of reporting options to meet the DRP model's requirements Re-configuring the functionality of Materials Management according with the ultimate model designed for the process of procurement of indirect materials	Plan: Configuring and Tailoring the ES functionalities related to transport operations and B2B.
	As part of the system configuration and tailoring loop	Development of an interface between the ES and the legacy HR application Development of further reporting options to meet the sales department's 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-users training	As part of the sequence of activities	Operational training of the HHC application for the sales force and intermediaries	Operational training of the functionality of DRP for the finished goods warehouse's end-users	Operational training of the sales budget application for end-users (mainly managers of sales centers)	Plan: Operational and Conceptual training of functionalities to be implemented
	As part of the training loop	Operational re-training to the D&S end-users in order to reduce deficiencies found through the help desk	Operational re-training to the manufacturing area's users	Conceptual training to new managers.	

System Configuration and Tailoring

A number of examples of configuration and tailoring are available in the CC study. For example, to support the distribution and sales process, the system was configured to support company credit policies to control sales intermediaries. The system was also tailored in several ways. Examples of tailoring were:

- an interface between the ES and a human resource application from a third-party provider;
- the creation of fifty new data outputs and reporting options for areas such as distribution and sales, finance, and purchases;
- programming in the provider's language to adapt the system to calculate the distribution requirements to remote warehouses according to the company's practices.

A development of this tailoring initiative, was to programme the system to record the intermediaries' clients (i.e., retailers) and their purchases. This programme ensured that these clients were not recorded by the system as CC's clients (its default behaviour), but as a separate level of market contact. For CC, it is important to record this information in order to track the company's total market whilst being able to differentiate between intermediaries and retailers. This tailoring exercise embraced the development of a novel application based around hand-held computers (HHCs). CC gave HHCs to its intermediaries so that they could record all transactions with these final clients. An interface between the ES and the HHC's application was developed.

Some of CC's key users acquired the skills and knowledge necessary to configure the system themselves. However, they initially relied solely on ES technical specialists for tailoring. This was augmented as, through Learning Cycle No. 2, CC's IT department also developed capabilities in the product's language.

End-User Training

CC's policy was that training should immediately precede system use by staff. The plan was for key-users to be responsible for training end-users. In reality high personnel turnover affected the way the company tackled this activity. This turnover necessitated that consultants often occupied the trainer role instead of key-users. Gradually the problem diminished as CC addressed the turnover issue. 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 key users learned about training itself.

ES-Use and Associated Loops

The ES implemented in CC was considered by many users as complex to use. Some 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. It follows that Learning Cycle No. 4 acts clearly as experiential learning. Note that two particular mechanisms helped in this learning process.

- First, users exchanged information and experience to tackle operational problems by sharing "tricks."
- Second, a help desk was created to answer questions. The latter was key in the case of regional warehouses and sales centers where users were relatively isolated, and unable to rely on the insights of colleagues.

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 other users. This latter need became increasingly significant in the first years of the process because conceptual training was often poor in the initial training activities. In subsequent years, CC paid more attention to conceptual training as part of this end-users training activity.

The training activities combined with the experience of using the ES to increase conceptual understanding about the integration concept underpinning ES. In CC several mismatches emerged between the modeled and actual processes. These mismatches necessitated the action of the business adaptation loop and the system configuration and tailoring loop. One remarkable example related to the procurement of indirect materials. This mismatch emerged because the ES was tailored to follow the way CC performed this process prior to implementation. First, CC tailored the system to support a requisition for material (RFM) from departments to the central warehouse. This procedure was not in the system's standard functionality. Second, this RFM was printed so as to follow an approval chain. The manual process worked for goods supplied internally. However, if the required material was not available in the central warehouse, the printed RFM was then sent to the procurement department, who created a purchase order to the appropriate supplier. This involved the re-entry in the system of the Data previously used to create the RFM required re-entry into the system(Figure 2). As one can deduce, this initial solution did not exploit the potential for ES to integrate effectively. On the contrary, CC "just paved the cowpath" 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 (Figure 3).

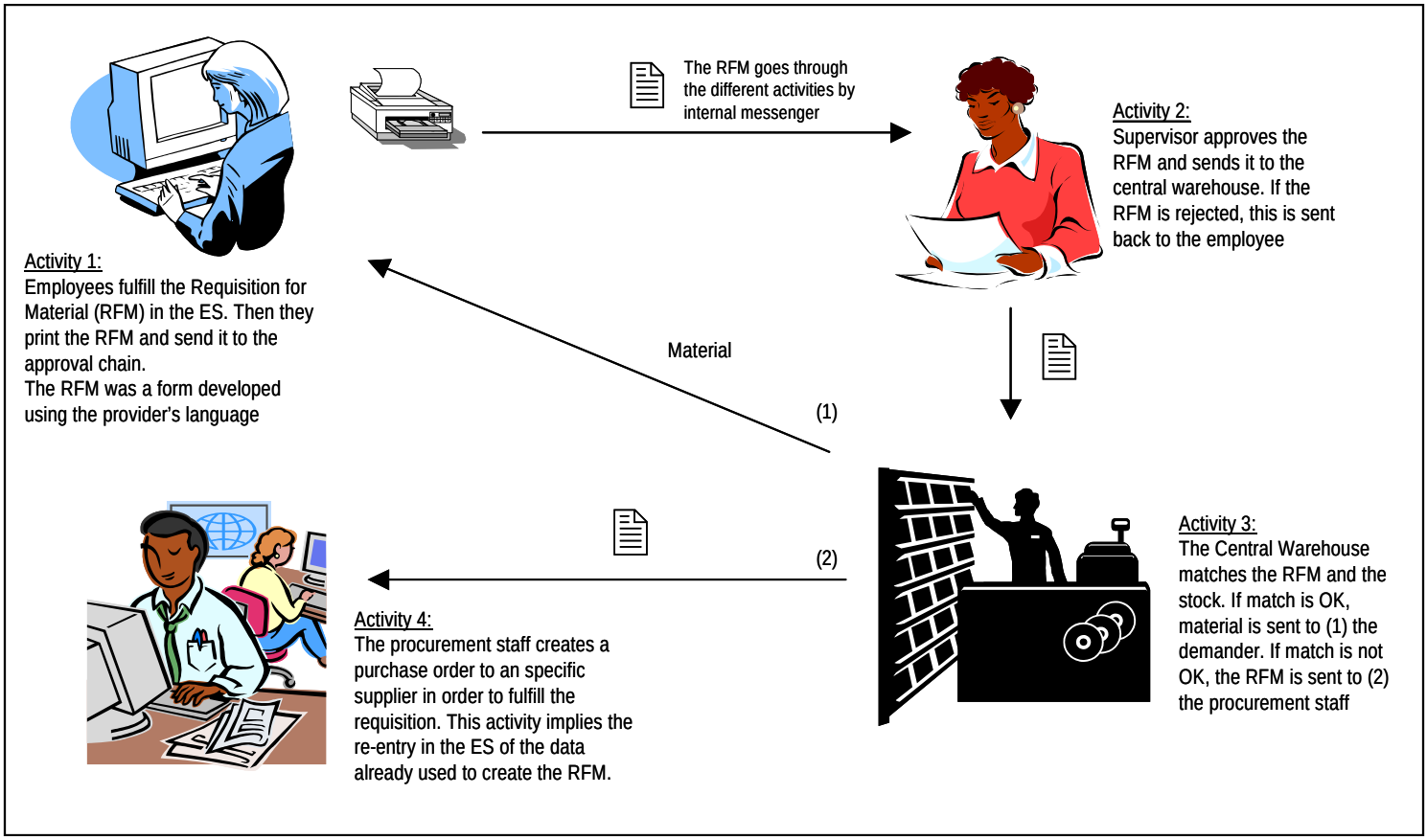

Figure 2 The Procurement of Indirect Materials Using the RFM - Before the Loops

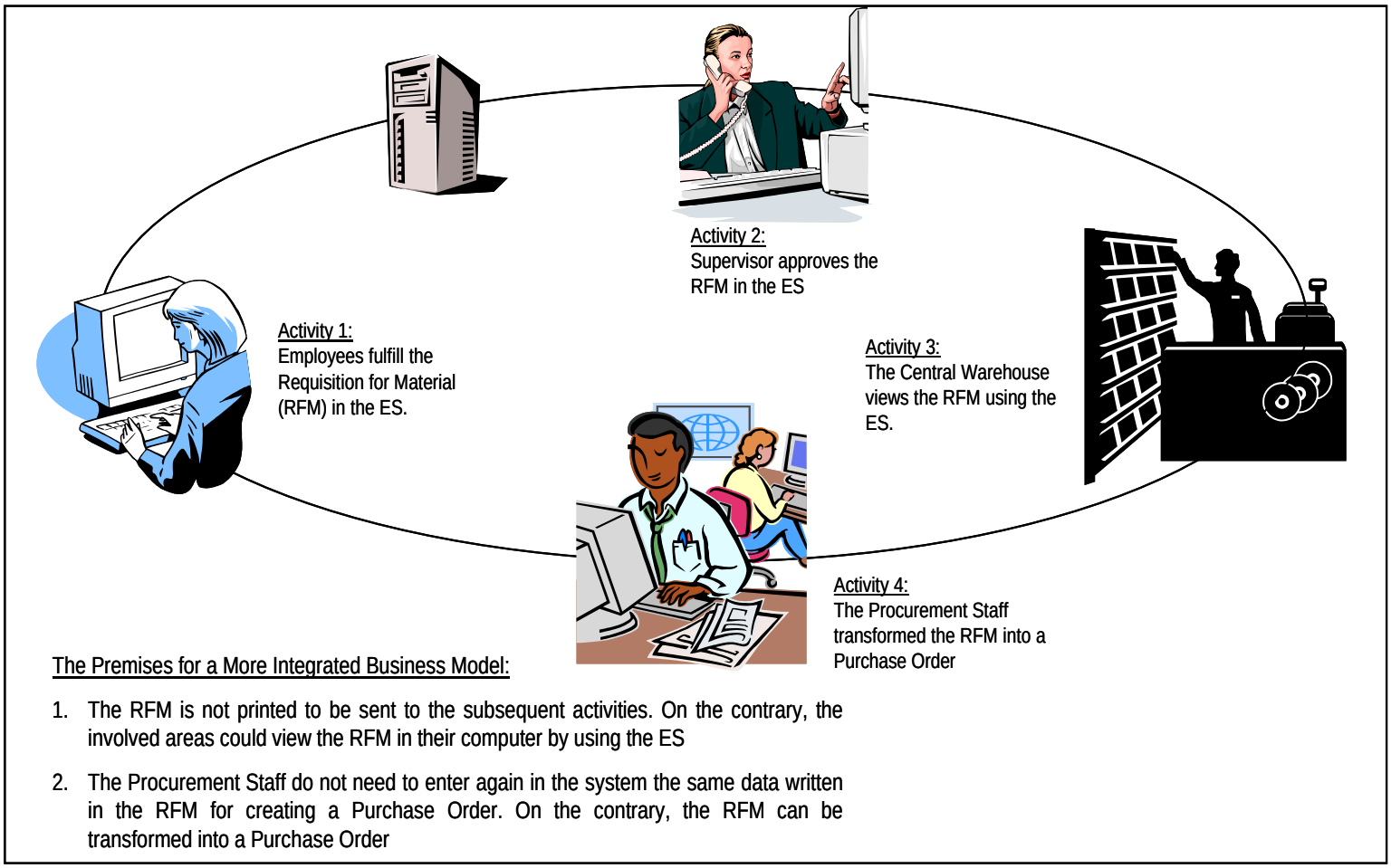

Figure 3. The Procurement of Indirect Materials Using the RFM - After the Loops

The operation of the Business Adaptation Loop was illustrated by issues associated with the cost accounting system. After gaining experience with the manufacturing functionality, the company learnt more about the system's options. The result was review of the existing cost accounting model. The Business Adaptation Loop was activated. Given that CC manufactures coffee with different specifications (i.e., different blends to produce distinct qualities), key users redesigned the model to record costs by production batches. This change motivated an organizational adaptation. Once a batch is completed, the production manager now is responsible for closing the batch in the system. As a result, the production area became a key element in completing the accounting cycle. Any delay from the production manager could affect the work of the accounting staff in preparing monthly financial statements. The integration philosophy underpinning the ES needed 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". The remaining 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 functionality of sales and distribution to its twelve regional warehouses and sales centers. Three applications of this cycle can be demarcated:

- the rollout of the purchase functionality into seven remote procurement centers;
- the rollout of the distribution and sales functionality into twelve distribution and sales

centers; and

- the rollout of the HHC's application and its interface with the standard ES into twelve distribution and sales centers. Key users recognized that "later rollouts were more straightforward than the earlier ones". Thus the knowledge identified in Learning Cycle No 5 relates to the methodological know-how of rollout.

When CC felt 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.,

> *"The objectives moved in the degree to 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".* CC's CEO.

The enhancement cycle was applied several times in CC. Over five years the following functionality was diffused through the company: financial accounting, manufacturing, materials management, service, distribution and sales, and DRP. Over the same period, applications from third-party providers (e.g., the HHC's application and the payroll) or developed 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, in 2004 was the development of a B2B initiative requiring the extension of ES functionality into CRM and e-procurement.

The Diffusion of the ES in CC: A Summary of Activities

Table 3 describes the most important events related to the activities and cycles of the CC 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 accomplished the rollout of the full functionality of its ES in support of the company's functions and business units. The rollout 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 these functionalities into the seven remote procurement centers, and twelve regional warehouses and sales centers.

The process conforms in broad part to a wave-like pattern, as the new functionality selected at the outset of the enhancement cycle are launched to the organization. What follows are a complex series of perturbations or ripples as some functions proceed in a relatively straightforward way, whilst others are more complex and require amendment. The progress of the financial accounting and materials management functionalities show the complex dynamic behaviors 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 remodeled, influencing both the finance and manufacturing function. Meanwhile, the adoption of materials management functionality was already underway (the 1st half of 1999, Table 1). 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 3). However, late on in the first half of 2002, this functionality was again under review and it was reconfigured to meet the demands of a new process model. In the second half of 1999 conceptual training was given as result of deficiencies found in the way users operated the system. Since then, such training was introduced as a compulsory component in end-users' training activity (see the End-users Training activity in Table 3).

CC substantially remade itself around the model provided by the ES system. The system affected role structures, procedures and policies, job turnover, skills levels of the workforce, and supply-chain relationships. Through the same process, the system itself was also configured and tailored to fit company requirements (System Configuration and Tailoring in Table 3). These continuous adaptive efforts were realized by to maximize the effectiveness of the new technology.

ENGINEERING SERVICES COMPANY (ESC)

ESC is a corporation made up of a group of companies acting as cost centers responsible for their own results. These companies can be categorized under three main business units:

- Engineering, Procurement and Construction (EPC),
- Petroleum Operations (PO), and
- Telecommunications Operations (TO).

Although these three business units operate independently within ESC, ES implementation was managed by a centralized team. The Corporate Finance Officer (CFO) was assigned as the project leader. The way that ESC defined its implementation objectives and planned and performed its ES project, dictates that it is considered here as a single case.

Table 4 shows the diffusion process for ESC.

Selection of New Functionality for Implementation

ESC began implementation of the functionality of Financial Accounting as a central repository of all transactions in all of three business units. The major goal of this implementation was to: reach a more accurate and faster corporate financial consolidation; and gain access to detailed business information in order to make better business decisions. As

> *"we had a lot of small systems without any connection between them, which resulted in data redundancy, inaccurate data, and a long time in developing any consolidated data; …all of this caused the Executive Committee to think about how to sort this problem out; …we all wanted a new technological platform able to integrate and unify all our business units for having consolidated information."* ESC's CFO

The functionality of Financial Control was implemented in parallel alongside the functionality of Financial Accounting. After these implementations, the ES vendor invited ESC to participate as a pilot in the country for the implementation of its Payroll functionality. The company accepted the challenge and Payroll (as a part of the Human Resources solution) began implementation across all business units. Later again, other Human Resources functions such as Training and Personnel Assessment were implemented. In addition, specific functionality was selected for each business unit. For example, the EPC unit asked to implement part of the functionality of Project Management and Time Recording so that it could record the costs of each project.

Process Modeling And Organizational Adaptation

Process modeling and organizational adaptation led to several key learning episodes for ESC. The first processes modeled were financial accounting and cost accounting. EPC being a grid structure, a key need was to measure costs of both project and functional areas.

> *"We want to view the organizational results from the two sides of the matrix; the financial return of the mechanical engineering department and the return of a specific project."* CFO

Through the modeling activity, key users developed a virtual accounting system drawn up in all dimensions, as they had wanted.

Table 4 The ES Diffusion Process in ESC: Events by Chronological Time Periods and Activities-Loops

		1997	1998 (1st half)	1998 (2nd half)	1999	2000	2001	2002 (1st half)	2002 (2nd half)
Enhancement Cycle	Selection of the new functionality for implementation	The functionality of Financial Accounting (FA) and Controlling in some companies. The functionality of Assets Management for d recording the depreciation The functionality of Sales & Distribution, and Materials Management in the Telecom Unit EPC: The time recording functionality in EPC; part of the project functionality needed to handle costs centers along with FA & CO		The functionality of Human Resources (HR) (to handle the payroll process) in some companies			Part of the functionality of MM for EPC projects (required by a partner) The functionality of HR (to handle training) The localization of Inflation Adjustment The functionality of Financial Consolidation Complete the functionality of Assets Management to work adequately with Inflation Adjustment and Financial Consolidation	The functionality of Business Intelligence from a third-party provider The functionality of Resource-Related Billing	<u>Plan:</u> The functionalities of Project and MM to handle EPC projects The functionality of HR (to handle personal assessment)
	Rollout of functionalities already implemented		The financial accounting and controlling functionalities into the rest of companies.	The human resource functionality into the rest of companies of the all business units.		The time recording functionality into the EPC regional offices			

		1997	1998 (1st half)	1998 (2nd half)	1999	2000	2001	2002 (1st half)	2002 (2nd half)
Process Modeling & Org. Adaptation	As part of the sequence of activities	Modeling: 1) the financial and controlling processes; 2) the billing process (hour-man); 3) the time recording process (changes in procedures of collecting, registering and processing of timesheets); 4) parts of the sales, materials management, and project processes		Modeling the payroll process Change of roles in the HR department. Change of procedures such as registering of holidays and permissions to leave temporally the office (e.g., post-natal). Adapting to the system			Modeling part of the procurement and payment control processes in the EPC unit Modeling the training process Modeling the financial consolidation process Modeling the inflation adjustment process	Designing Performance Indicators as part of the ISO 9000 requirements Modeling scenarios of billing for the billing process	<u>Plan:</u> Modeling the procurement and project processes in the EPC unit Modeling the personal assessment process
	As part of the business adaptation loop			Changing the controlling model by reducing the types of activities and costs centers in order to ease data entry in the time recording functionality.	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 Center for Time Processing	New procedures and roles to fix mistakes that emerges after validating the transferred data in the time recording process		<u>Plan:</u> New procedures and roles to register, approve, and transfer data in the time recording process as a consequence of a workflow system

		1997	1998 (1st half)	1998 (2nd half)	1999	2000	2001	2002 (1st half)	2002 (2nd half)
System Configuration & Tailoring	As part of the sequence of activities	Configuring the functionality of FA and CO. Programming in the provider's language a solution for the billing process Configuring the time recording and parts of the functionalities of AM, CO, MM, and D&S.	Configuring the functionality of FA and CO.	Configuring the functionality of HR (payroll) Programming further functionality for calculating a specific value of remuneration according to the sort of employee in the payroll functionality	As a consequence of introducing the HR functionality, it was necessary to reconfigure some parameters in the functionalities of time recording and financial accounting		Configuring part of the functionality of MM to handle the procurement and payment control processes for EPC projects. Configuring the functionality of HR (training), Assets Management, Inflation Adjustment and Financial Consolidation.	Three developments (user-exits) to enter data in the functionality of Resource-Related Billing. Evaluating the possibility of an interface between a project software from a third-party provider and the ES.	Plan: Configuring the project and materials management functionalities Configuring the personnel assessment functionality
	As part of the system configuration and tailoring loop		Some troubles were fixed in the billing application. Then the development was cancelled. New billing functionality would be release soon by the 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 for detecting mistakes in the data entry in the time recording functionality Development of reporting options to meet the users' requirements using the functionality of HR	Developing a front-end application in a language from a third-party provider 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 the adjustment of inflation in the value of purchase orders in MM functionality. Development of reporting options in MM.	Development of reporting options to meet the users' requirements using the functionality of inflation adjustment Fixing the report of tax retentions for adding further fields	<u>Plan:</u> Developing interfaces and jobs for introducing a workflow system in the time recording process

		1997	1998 (1st half)	1998 (2nd half)	1999	2000	2001	2002 (1st half)	2002 (2nd half)
End-users training	As part of the sequence of activities		Operational training of the FA and CO functionality for end-users Operational training of functionalities of MM, D&S in the telecom unit. Poor conceptual training		Operational training in HR functionality (payroll) for end-users. Training in Windows for the HR department's end-users Poor conceptual training		Operational training (i.e., how to operate the system) of the functionality of MM for end-users in the EPC unit. Better conceptual training was activated	Operational training of the functionality of Business Intelligence and Resource-Related Billing for end-users in EPC Operational training of functionality of Assets Management, Inflation Adjustment and Financial Consolidation for end-users in EPC	Plan: Operational training of the functionalities of project, MM for the EPC's end-users Operational training of the functionality of personnel assessment for the HR's end-users Operational training of the workflow system for the EPC's end-users
	As part of the training loop			Retraining end-users in the FA functionality according to the deficiencies found.			Retraining end-users in the HR functionality according to the deficiencies found.		

operation and as a result, the Business Adaptation loop as a learning and improvement cycle was set in motion several times (see the ES-use activity below).

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 and the company's payroll scheme. Other examples were:

- The development and adjustment of data outputs and reporting options for areas such as finance and human resources (i.e., adding fields to standard outputs)
- The development of interfaces between legacy systems and the ES. For instance:
- Using batch input into the ES from the legacy payroll system;
- Using batch input into the ES from applications developed by the company to ease the entry of some sorts of data such as expenses.
- Programming further functionality using the provider's language for billing man-hours.
- Programming further functionality for calculating a specific value of remuneration according to the sort of employee in the payroll functionality.

End-User Training

Users reported that training was poor and undertaken very quickly during the first stages of the implementation process. For some users this "race of going live". resulted in negative consequences for the use of the system. Many hands-on training sessions were carried out, but no conceptual training was given at these early stages.

> *"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 how the information flows through the system."* A key user.

As a consequence, the ES project manager developed a training method which she entitled 'The Four Training Levels for ES.' The first of these levels focuses upon a conceptual understanding of ES. No specific knowledge about the system is required to attend this level. After this conceptual introduction, end users could take operational training courses for their specific areas.

ES-Use

As with CC, users at ESC reported that the system was unfriendly and difficult to use. Some reported that it ran at a slow speed, others disliked its displays (e.g. data entry screens and/or reporting screens), or commented negatively on the long entry-path involved in doing many transactions. Deficient training might have been responsible for some of these complaints. It follows that an important part of the learning experience came with using the system over time. Users exchanged their experience of using the system with one another, allowing the company to speed up the learning process. Thus 'Learning Cycle No. 4' acted here as experiential learning. In addition, because of the deficiencies found in the first training activities, the 'training learning loop' was also activated for some users.

The time recording process in ESC was subject to considerable activity, embracing both the Business Adaptation Loop and the System Configuration and Tailoring Loop. After using the system, users found a large gap between the modeled process and the process as performed. This mismatch motivated a learning and improvement exercise, lasting over three years to achieve the expected performance levels. The various improvements and adjustments to the process, procedures and the ES were realized to improve the data quality and reduce the processing and delivery time. ESC already documented some of these improvements in an internal document as part of the company's quality management system. Evidence is presented from this document to show how the 'business adaptation loop' and the System Configuration and Tailoring Loop operated here. A set of improvements was carried out. Examples are:

- Easier data entry by reducing options in the ES (System Configuration and Tailoring).
- Implementing validations to run validations for detecting mistakes in data entry (System Configuration and Tailoring).
- Running transaction "jobs" daily to support the information needs of corporate projects and to remove the need for local databases (Business Adaptation and System Configuration and Tailoring).
- Implementing validations in the transfer process (System Configuration and Tailoring). Validations involved the creation of a query to compare the data inside the temporal database with the data transferred into the application database. Before this improvement was made, mistakes were found informally by users, and the tracking and fixing of errors grew time-consuming.
- Decentralizing the CTP from corporate headquarters to remote offices (Business adaptation).
- Implementing electronic timesheets and a workflow system (Business Adaptation and System Configuration and Tailoring).

The 'enhancement cycle' was applied several times over five years in ESC. As with CC, when ESC thought it 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.

"Our implementation objectives have moved according to 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)." EPC's CIO

> "New needs are stated annually; …based on this, an annual plan is released, which defines the functionalities to be implemented or rolled out over the next months." EPC's ES Support Manager

Summary of Activities

Table 4 shows the major events related to the activities and cycles of the diffusion process in ESC over time. After nearly six years, incorporating many phases of design, use, and rollout, ESC still only partially completed the implementation of the full functionality of its ES. Further adoption and rollout was planned. Up to 2002 the ES implementation encompassed the functionality of Financial Accounting, Control, Time Recording, Payroll, Training, Financial Consolidation, Financial Localization, and third party applications. It also encompassed the rollout of Financial Accounting, Control, Payroll and Time Recording into the rest of business units and regional offices (see Enhancement Cycle in Table 4). However, the operation and management of EPC's projects was still being performed using legacy systems. It was not until the second half of 2002 that the company started to address these processes.

VI. CONCLUSIONS

This research is concerned with the development of a technological diffusion perspective of ES. The four concerns set out for the paper are:

- To model the diffusion process for ES;
- To recount the characteristics of ES projects through the model;
- To reflect critically on the validity of the model and its development;
- To reflect critically on the nature of the ES diffusion processes.

In presenting the first two of these concerns, the reader was introduced to the great detail and variety of the ES process. The case descriptions convey the long, intense and didactic nature of

ES adoption. Far from being a sterile execution of an implementation lifecycle, the enlarged diffusion perspective accesses the processes, social dynamics, and learning episodes of ES. The case studies constitute a considerable journey!

Essentially the model assists access to this complexity, allowing its description and the characterization of the many different behaviors that are involved. It provides a lens for seeing into, and filtering within, the various complex organizational behaviors associated with new ES. In so doing, it is possible to appreciate the span and the intrinsic nature of the ES process itself. Much of the account is concerned with learning.

The diffusion perspective differs critically from traditional software lifecycle accounts by placing 'use' in the center of the discourse, as both product and fomenter of adoption activity. Use is both fountainhead and undercurrent in the adoption process: a very different depiction of the dynamics of software adoption to that in conventional implementation models which see it rather mechanistically as the output to a series of preceding activities. Hence, this new perspective puts rather more emphasis on the importance of experiential learning than some accounts [e.g., Markus and Tanis, 2000] and reaffirms the important role of knowledge creation and sharing [e.g., Soh et al., 2000]. In so doing it relies very much on concepts of experiential learning proposed by Kolb [1984] and Argyris [1992]. We see in several examples how key-users and users in CC and ESC learn through their experience, relying on their exposure to the ES to carry out several key enhancements. We see also several reflective accounts from actors in both case studies as they identify "mismatch between intentions and outcomes" [Argyris, 1992].

Hence the ES diffusion model presented here puts use amidst a network of knowledge flows and learning episodes. Thus presented, it raises the real and beguiling prospect of the development of diffusion methods for ES. A model which describes the dynamics of learning and diffusion might facilitate the development of methods based upon this broader perspective. Such methods will emphasize the need for learning across the various different activities in the process. Of course, the model as presented was not used in this prescriptive way, but rather it reflects the planned and de-facto behaviors of the case study sites. It must also be subject to further scrutiny.

Turning then to the validity of the model and its developments, we showed how the model derives from deep engagement in case study research. However, it can be acknowledged that its validity is constrained by its exposure to just three sites. Features of ES diffusion may exist which were not seen in these sites and are not described in the model. Moreover, methodological restrictions arise from the researcher/user relationship. Although users were asked to be critical of the model, issues can arise from this relationship (e.g., faith being placed in the researcher because of his role). Nonetheless, ready extensions to this research will likely remedy any deficiencies (e.g., further case studies and survey).

The value of the model is described in metaphorical terms. It constitutes a lens, a means of viewing and classifying organizational behaviors. Moving beyond this metaphor, the studies described help in attaining a holistic appreciation of the complexity of ES adoption. Complexity is the fourth of the concerns of the paper.

The studies show how the diffusion of ES throughout the organizations was an iterative, cumulative, and virtuous process over time. The studies convey that it is the different dimensions of

- business adaptation and
- system configuration and tailoring

which represent the authentic signature of the ES implementation experience. These dimensions fulfill Markus and Tanis's [2000] and Brehm's [2001] observations, that ES projects live with different tensions across business process redesign, configuration, and coding. In CC and ESC, it can be seen how these dimensions represent different kinds of obstacle in the diffusion journey. Many examples are available. For example, organizational roles in CC were changed as a result

of the adoption of the ES to support its sales and distribution processes. The same area of ES functionality was itself extended to support the recording of sales due to intermediaries. Hence, the adoption process can be characterized as seeking a series of minimal, critical changes across these different dimensions of organizational adaptation and system change. Implementation can be likened to a process of metamorphosis as the organization reconstructs itself around the new skeleton provided by the ES. Through this painful process, the guiding principle of minimal, critical change results in a series of trade-offs between the different tasks of organizational change, system configuration, and system change. In both CC and ESC a de-facto result is to prioritize business adaptation and system configuration rather than tailoring. This strategy (i.e. coding as a last resort) replicates the findings of other case studies [e.g., Kawalek and Wood-Harper, 2002].

ACKNOWLEDGEMENTS

The first author gratefully acknowledges the support of IESA (Caracas, Venezuela) for this research and would like to thank over seventy business managers and specialists participating in this study. Special thanks go to Juan C. González, Rafael Hernández, and Antonio Vicentelli who allowed us to undertake this research in their companies.

Editor's Note: This article was accepted by Christopher Holland, Senior Editor of CAIS. The article, which was fully peer reviewed, was submitted in May 2003. It was with the authors for two revisions. The article was published on April 21, 2005.

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APPENDIX I. CPS CASE

Table A-1 presents the progress of diffusion CPC. CPS experienced many of the same learning situations as were observed in the CC and ESC cases described in Section V.

Table A-1. 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		

		1996 - 1997	1998 - 2000	2001 (1st half)
	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	

		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 &	As part of the sequence of activities			

		2001 (2nd half)	2002 (1st half)	2002 (2nd half)
Org. Adaptation	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.		

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Communications of the Association for Information Systems

ISSN: 1529-3181