A COMPREHENSIVE REVIEW OF THE ENTERPRISE SYSTEMS RESEARCH

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Abstract

Enterprise systems (ES) can be considered as a novel phenomenon for the information system research and other academic fields (e.g. operations and supply chain), which has opened an imm—ense potential and opportunities for research. Although the interest of the scholars on ES is recent, the number of publications is continuously growing since 2000. The aim of this paper is to review a sample of important contributions of the ES works published to date. To do this, the selected works have been classified in four key topics: business implications, technical issues, managerial issues, and implementation issues.

Keywords

Enterprise Systems, Research, Bibliography

INTRODUCTION

Although enterprise systems (ES) appeared in the market more than a decade ago, the interest of the scholars on ES is recent (Esteves and Pastor 2001a). By matching two previous works, which include a comprehensive literature review of ES (Pa rr 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 ¹. To 2000 there were just ² (Esteves and Pastor 2001a). After published twenty-one works on ES in IS journals 2000, the number of publications had increased. The interest of the IS community and ES-related areas, such as Supply Chain Management and 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; Ros emann 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 information system research and other academic fields (e.g. operati ons and supply chain), which has opened an immense potential and opportunities for research (Markus and Tanis 2000).

ES BIBLIOGRAPHY CATEGORIES

This section aims to review a sample of important contributions of the ES works published to date (see Table 1). To do this, the selected works have been classified in four key topics: business implications, technical issues, managerial issues, and implementation issues.

Table 1
A Sample of ES Research by Main Topics and Areas

ES Topic	Areas of Research	Authors		
Business	Strategic and Organizational Implications	Davenport (1998; 2000)		
Implications		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)		
	Evolving	Markus (2000)		
		Light et. al. (2001)		
		Lorenzo (2001b)		
		Scott and Kaindl (2000)		
		James and Wolf (2000)		
		Chung and Snyder (2000)		
		Sproot (2000)		

¹ AMCIS: The Americas Conference on Information Systems ICIS: The International Conference on Information Systems PACIS: The Pacific Conference on Information Systems

² The journals reviewed by Esteves and Pastor en compassed: ACM, CAIS, DSS, EJIS, HBR, IJIM, ISJ, ISR, JGIM, JIT, and MISQ.

ES Topic	Areas of Research	Authors
Managerial	Knowledge Creation	Newell et. al. (2001)
Issues		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	Critical Success Factors	Holland and Light (1999)
issues related to		Esteves and Pastor (2001b)
adoption,		Parr et. al. (1999)
installation		Bancroft et. al. (1998)
project,		Shanks et. al. (2000)
diffusion, and		Stefanou (1999)
uses.		Summer (1999)
		Reinhard and Bergamashi (2001)
	Success Measures	Markus and Tanis (2000)
		Markus <i>et. al.</i> (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)
	T	Whang et. al. (1995)
	Long-term requirements and challenges	James and Wolf (2000)
		Shepherd (2001)

Business Implications

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 th e 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 compa ny 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 ow n. 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 of each in terms of decision -making implications 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 changes of organizational roles, and customer satisfaction. These efficiency. implications were measured by them under the lens of users' perceptions.

Technical Issues

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.
- 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, configur ation 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. In addition, works in this area have also asses sed 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." Evolvi ng 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 enhance d 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 (s ee 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 adopt ion of an ES. Sproot (2000) attempts to foresee how the componentisation of ES will evolve.

Managerial Issues

ES projects are "managerially challenging" (Markus and Tanis 2000). The research around this concern encompasses the following areas: 1) knowled ge 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 appropriatio n 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 (20 01) 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 (Ma rkus 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 contex t. 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.

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 activitie s (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 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 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 20 01; 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).

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 o f 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.

Table 2 A Sample of Critical Success Factors for the ES Implementation by Authors

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

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 op eration' 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 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 practitioner s and managers prefer prescriptive models (Markus and Tanis 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 succes s in the adoption of CASE packages (Smyth 1999). The model is shown in Figure 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.

Table 3
Success Metrics for the ESEC Phases

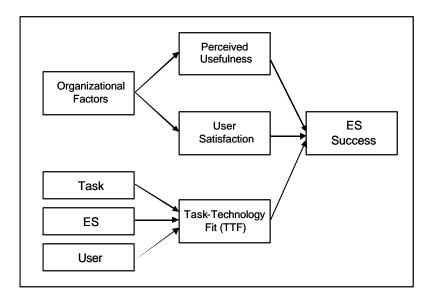
Phase	Success Metrics
Chartering	Quality of business case
	Fit with business strategy
	Adequacy of schedule and budget
Project	Project cost relative to budget
	Project completion time relative to schedule
	Completed and installed system functionality relative to original project scope
Shakedown	Short-term 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 telephoneorder
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)

Descriptive Case Studies

Perhaps descriptive case st udies 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 1
The Smyth's ES Success Model



Source: Smyth (2001)

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, 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; Bre hm 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. 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 tha t 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 fo r 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 understan d 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.

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 theorie s, 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. Imple mentation 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 re search 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 di ffusion, 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.

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