Archival Analysis of Enterprise Resource Planning Systems: The Current State and Future Directions

Research-in-Progress

Introduction

In 2000, scholars Estevez and Pastor completed an archival analysis of Enterprise Systems (ES) research, published in Communications of the Association for Information Systems. The objective of the authors was to establish “an annotated bibliography of the ERP publications published in the main Information Systems conferences and journals and to review the state of art in this area” (Esteves and Pastor 2001, p1). In the study, the authors categorized journal articles according to the lifecycle phases of ERP system and further studied the articles within granular topics of interest. Six years later in 2006, using the same classification system and analytical approach, Estevez and Bohorquez produced an updated annotated bibliography (Esteves and Bohorquez 2007), focusing on the period 2001-2005. For this, the scholars eliminated incongruities in the first paper and added a “significant number of new publications in all the categories” (Esteves and Bohorquez 2007, p1). Building on Estevez and Pastor and in the spirit of building cumulative knowledge on ES, we build an archival analysis of ES studies from 2006-2012 to comment on the current state of ES studies and to direct future research on this important phenomena.

This study is timely, not simply due to years elapsed since last published archival analysis on ES. But, such an archival analysis will lead researchers and practitioners to understand the current status and future directions of a complex system. Contemporary organizations continue to devote substantial resources to acquire, maintain and upgrade ES, yet with some degree of uncertainty of ES benefits. Moreover, current developments in technology platforms and global markets demand that ES are delivered to Small and Medium organizations with affordable access platforms. Notwithstanding the above, contributing to the conjectural discussion of the evolution of ES as a domain, it could be revealing to understand the future of ES research, and also to seek to answer why scholars rarely move beyond the established tracks of research (e.g. ES lifecycle on implementation, adoption and use).

For the novice ES researcher, our analysis provides a summary of published research areas and identifies gaps to develop their study focus. For established researchers, the archival analysis captures insights on areas of research that have reached theoretical saturation. In conducting the archival analysis, our overarching research questions are: “What are the trends and patterns of ES research established between 2006-2012?” “What areas and topics must be researched to develop a better understanding of ES phenomena?” To address the above question, our approach consists of three prongs: consult an exhaustive list of ES literature to trace the top researched areas, organized through the widely adopted ES performance lifecycle (c.f. Ross et al. 2003) (2) within identified areas of interest (later identified as implementation), conduct an extended analysis of the nature of research and (3) identify topics that stagger through a periodic analysis from 2006-2012. Therefore, our study seeks to extend the work of Estevez and co. in at least these three ways.

The remainder of the article is organized as follows. First, we discuss the archival method. Next, we present our preliminary analysis, focusing on across topic, within topic and across time periods. The paper concludes with a discussion on areas for future research.

Archival Method

We perform an archival analysis on ES from the years 2006 to 2012 on the top Information Systems (IS) journals. As earlier mentioned, this study is underpinned by the annotated bibliographies by Esteves and Pastor (2001) and Esteves and Bohorquez (2007). It extends the past work by analyzing a different time period (2006-2012), (2) consolidating its nature; we examine for a body of literature, the stakeholders perspective sought, the country the research originated in and the mode of analysis utilized and (3) comparing across three analysis 2001, 2007 and now 2012.

This archival analysis is both a continuation and an extension of work performed by Estevez and Bohorquez (2007) hence the same journals were used in the analysis, with the exception of the addition of the Journal of the Association of Information Systems (JAIS) which has been included as it
has been identified in the AIS Senior Scholars’ Basket. Research has been performed into the ERP lifecycle in its entirety and individual components, and into education, development issues and business modeling tasks. To retrieve the articles from the aforementioned sources a search was performed for articles that contain but are not limited to the following terms in the title, abstract or keywords: ERP, ES, enterprise-wide systems, packaged software, and the ERP vendors: SAP, Oracle, Baan, JD Edwards, and PeopleSoft. Each of the articles returned by the search was read in full and the relevance of the articles was determined. Irrelevant articles were discarded and relevant articles were classified according to an extension of the classification scheme performed by Estevez and Bohorquez (2007), with appendix 1 depicting the articles read.

**Analysis, Findings and Discussion**

This section summarizes the results obtained for the review of the literature from 2006 to 2012 and then compares the results to the results obtained from Estevez and Pastor (2001) and Estevez and Bohorquez (2007). The reason for the cross comparison is first to identify if the research trends are changing or if certain categories appear to be getting a majority of the researchers focus. A granular analysis of the topics will ensue. This is followed lastly by a periodic analysis.

**Across Lifecycle Analysis: An Account of Popular Topics**

The enterprise systems lifecycle developed by Esteves and Pastor (1999) consists of 6 phases, which are adoption decision, acquisition, implementation, use and maintenance, evolution and retirement. The adoption decision phase consists of the decision of the organization to implement an ERP system, requirements analysis, the objectives, and evaluation guidelines for the ERP system are defined at this level. Once an organization has decided to adopt an ERP system the ERP vendor needs to be selected. The determination of the vendor is referred to as the acquisition phase, and contracts are drawn up and the return on investment is estimated. Once the vendor is decided upon the next phase consists of the implementation process, which consists of the implementation and customisation of the system to meet the requirements that were specified in the adoption phase. After the system has been implemented, the lifecycle focuses on the use and maintenance of the ERP system with the objective of maximizing the benefits. Evolution phase focuses on the integration of new and existing technology to achieve greater benefits and maximize the fit to the requirements. The enterprise system lifecycle concludes with the retirement phase, which is when the organization decides to abandon the ERP system (Esteves and Pastor 1999). The results obtained from the surveying of the relevant articles from 2006 to 2012 and categorizing them in accordance to the enterprise systems lifecycle phases, general research topics and education can be seen in figure 1. The major ERP topic analyzed was implementation followed by usage and maintenance. Retirement was the least study phase in the ERP lifecycle and education related to ERP was the second lowest research area.

The adoption phase of the lifecycle focuses on the impact, approach, challenges and enablers for deciding whether an ERP system is necessary for the organization (Esteves and Pastor 1999). The main topics focused on by the past research includes: explorations of factors that influence adoption decisions (Chang et al. 2010; Wang and Ramiller 2009), the adoption process (Poba-Nzaou et al. 2008), risk management during adoption in SMEs. Also studied was a comparison of ERP to proprietary software (Benlian and Hess 2011; Olsen and Saetre 2007a), analysis of the reasons for adoption (Lorca and de Andrés 2011) and how the adoption decision effects the share market in the US (Ranganathan and Brown 2006). Most of the research performed in the area was from the perspective of top management, middle management, project team and consultants within the one organization. The acquisition phase of the ERP lifecycle focused on the approach and evaluations of choosing a particular ERP software product (Esteves and Pastor 1999). The research focused on the determination of the selection criteria for packaged software (Keil and Tiwana 2006; Tsai et al. 2012).

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application of the power relations framework and how actors shape the acquisition framework (Howcroft and Light 2006, 2010). Furthermore research was conducted to develop a list of principles to guide an organization in their decision making process (Damsgaard and Karlsbjerg 2010) and development of a methodology to determine the ERP system that best matches the requirements (Wu et al. 2007).

Figure 1: Number of articles per category

The evolution phase focuses on the integration of emerging technologies with the ERP system to achieve further benefits and to provide a better fit to the organization (Esteves and Pastor 1999). Several articles examined the integration of new technologies with ERP systems, these included ERP and SCM system integration (Bose et al. 2008), integrating vehicle routing tools with ERP systems (Mendoza et al. 2009) and frameworks developed to express the facilitators and inhibitors of enterprise application integration (EAI) technology (Bahli and Ji 2007). Several articles reviewed the coordination strategies of Software as a Service (SaaS) and the need for contracts between ASPs and end users (Demirkan et al. 2010; Susarla et al. 2009). Furthermore the issues of enterprise content management was investigated (Nordheim and Paivarinta 2006) as well as the critical success factors, drivers and barriers of ERP II implementation (Koh et al. 2011). This research was usually performed from the perspective of the project team, vendors, consultants, end users, top management and middle management. Most analysis was only performed in the one country per article, and the countries included, China, Germany, US, UK, Norway. No article compared and contrasted the use of the evolution in developed countries with developing countries, or with transition economies.

The retirement phase of the ERP lifecycle is when managers decide to opt for a new system that will fulfill the needs of the organization (Esteves and Pastor 1999). Only one article reviewed was categorized as part of the retirement phase of the ERP lifecycle. The article was from the perspective of top management and developed a model to explain the factors that cause IS discontinuance, which included system shortcomings and reduced support availability (Furneaux and Wade 2011). The category of education encompasses courses and curricula that universities offer students (Esteves and Pastor 1999). Only two articles were analyzed that pertained to education. Scott and Walczak (2009) analyzed whether a person’s judgment on their ability to use a system impacts the acceptance of technology. Wilson and Tulu (2010) focused on courses that utilized both information systems and health at tertiary education. The usage of the system in the ERP lifecycle focuses on how the system is utilized to achieve benefits and success as well as the maintenance of the system (Esteves and Pastor 1999). The research performed into the usage of the system focused on the factors that influence use (Klaus and Blanton 2010; Liu et al. 2011; Sun et al. 2009), evaluation models to assess if benefits are reached (Hakkinen and Hilmola 2008; Uwizeyemungu and Raymond 2009, 2010) and comparisons of non-implementing organizations to implementing organizations in the one industry (Goeke and Faley 2009; Romero et al. 2010). Furthermore research was performed into the maintenance of the system, which included techniques for encouraging users to upgrade software (Khoo et al. 2011a), impact upgrades have on stakeholders (Khoo et al. 2011b), and the forces that influence the decision to upgrade (Khoo and Robey 2007).

General Topics

The general category contains articles pertaining to research issues, business models and ERP product development issues. Figure 2 shows the segmentation of articles into the categories that comprise the general topic. Other implementation areas that were researched include the relationship between ERP
consultants, management consultants, managers and SME owners during the ERP implementation project (Chen et al. 2008) and analyzed how consultants and software origin affect the perceived misfit of the system (Wang et al. 2006). Comparisons were made across the levels of ERP absorption in transition economies to developed economies (Bernroider et al. 2011) and into the implementation time for business support modules to value chain modules (Santamaria-Sanchez et al. 2010).

Articles that were categorized as research issues included literature review and annotated bibliographies on ERPs and IS (Esteves and Bohorquez, 2007; Dietrich, 2006; Mignerat and Rivard, 2009), development and testing of models for the determination of whether the implementation will be successful, (Kweku-Muata et al. 2008) and for the economic potential of Service Oriented Architecture (Mueller et al. 2010). Furthermore comparisons were performed on the ES lifecycle in transitional to developed economies (Themistocleous et al. 2011). Research that was performed into business modeling included enhancing the alignment between ERPs and the business processes of an organization (Sousa et al. 2011), utilization of event logs in process mining applications so that business processes can be improved (Ingvaldsen and Gulla 2006) and analyzing whether the process being followed by an organization is the process that is defined in ERP (Aalst 2006).

Product development issues that were researched include the utilization of model-driven component-based software development to implement ERP systems (Subramanyam et al. 2011), communication in globally distributed teams through the use of collaborative technology (Oshri et al. 2007) and a comparison of prototype validation of packaged software (Klein and Herskovitz 2007). The biggest category by far is implementation and therefore warrants a more detailed analysis.

**Within Topic Analysis: An Account of Implementation**

The implementation phase of the ERP lifecycle focused on the approach, success and failure, organizational issues, knowledge management issues and other issues pertaining to the implementation of an ERP product (Esteves and Pastor 1999). The segmentation of articles into the various implementation categories can be seen in figure 3. Implementation success and failure was the most researched, followed by organizational issues, knowledge management issues, other issues and the least researched topic was approach. Other issues pertain to issues that arise in the implementation process that do not fit within the previously mentioned implementation categories.
Implementation success and failure was the most studied area of the implementation phase. The factors affecting the success of the ERP implementation project that were studied in detail in the research were top management support, consultant quality, organizational culture, governance, risk management, business process reengineering, communication and change management. Furthermore research was performed into linking the critical success factors of implementation to the expected organizational benefits (Doherty et al. 2012; Liu and Seddon 2009; Schubert and Williams 2011), analysis of actions that project managers can perform in relation to CSFs (Francoise et al. 2009) and reasons for ERP implementation failure (Momoh et al. 2010). A literature review was performed to identify a list of critical success factors in ERP implementation (Finney and Corbett 2007), critical success factor studies were also undertaken in China (Lin and Rohm 2009), Egypt (Sawah et al. 2008) and Iran (Dezdar and Ainin 2011). Comparisons were also performed with regards to critical success factors in public and private sector companies (Wagner and Antonucci 2009). A significant amount of research has been performed on critical success factors in ERP implementation, with developing nations, developed economies and transition economies all being analyzed by various methods of analysis, such as case studies, interviews and surveys.

Implementation approach was the least researched topic in the implementation phase of the ERP lifecycle. Research performed into this area include a comparison of the benefits and risks associated with an ASP hosted ERP system to a self-hosted ERP system (Solis et al. 2006), the approach taken by project management to handle multiple project implementation at the one time (Elbanna 2010) and configuration patterns were developed through the utilization of EPC and petrinets (Dreiling et al. 2006). Most of this research was performed in European countries and the USA, no cross country analysis was performed, and the results received cannot be generalizable to developing nations.

Organizational issues that have been researched include the factors that influence organizational performance (Amrani et al. 2006; Dhillon et al. 2011; Ignatidis and Nandhakumar 2007; Law and Ngai 2007), learning and training of the system (Davis and Hikmet 2008; Gravill and Compeau 2008), the importance of trust and communication in ERP implementation (Rose and Schlichter 2012; Thomas et al. 2007), and strategies to handle organizational groups (Klaus et al. 2010).

Knowledge management is a critical factor in ERP implementation success. The research has been focused on the identification of factors that impact the transferal of knowledge (Hung et al. 2012; Xu and Ma 2008), the mechanism of flow that occurs in the transferal of knowledge (Kotlarsky et al. 2008; McGinnis and Huang 2007) and propositions were developed to explain the factors that knowledge transfer influences (Srivardhana and Pawlowski 2007).

Periodic Analysis: Addressing the Stagger

The comparison of the results obtained from this study and the annotated bibliographies of Estevez and Pastor (2001) and Estevez and Bohorquez (2007) can be seen in figure 4. As observed ERP implementation has been the most previously studied phase of the ERP lifecycle, with the retirement phase receiving little to no focus. This is concerning as with time the research topics popularity should be shifting. As stated by Estevez and Bohorquez (2007) “critical success factors are quite well studied, however their operationalization is not”. Yet further studies have continued to try and define the critical success factors and stating the importance of top management support, consultants, change management and risk management. Several articles have since attempted to explain how the critical success factors can be put into practice to fulfill the gap in the literature.

The retirement phase is a critical aspect of the ERP lifecycle, it marks the abandonment of particular software, the reasons for the abandonment need to be studied further as if the reasons are known improvements and evolutionary technologies can be integrated within the system to provide further functionality. Therefore research needs to be performed into the following: (1) determining why organization are abandoning ERP systems, (2) which members of the team arrive at the decision to discontinue use of the ERP and (3) determining if there are any positive or negative impacts on the organization due to the retirement of the ERP system. This research needs to be performed from all stakeholders perspectives and in developing and developing nations and developed and transition economies as it has been shown that different cultures have different expected benefits and it may be the lack of these benefits that cause the abandonment of the system.

Interestingly the education of ERP systems in the research has been decreasing, this could be due to ERP being considered a mature technology and could be merging in the Information Systems realm of teaching, however several universities have compulsory enterprise systems units and majors, making them a focal point in teaching. Amidst university retention measures to counter attrition rates and the
emergence of software vendor-assisted academic alliances, graduate Enterprise Systems teaching is at an important crossroads. For this universities face a massive task of balancing investments into programs with the need to meet industry demand, which can potentially be offset through appropriate pedagogy. Whilst academics are forging new methods of enriching ES education through simulation games (Leger 2006) and seeking vendor assistance (Corbitt and Mensching 2000; Rosemann and Maurizio 2005) to keep up-to-date and explore the way forward in this landscape, scholars must be accountable for publishing methods of engaging students in an ES course. This creates the challenges (Markus 2005) and forces that have an effect on how educators can be/cannot be more innovative in their method to engage and attract students. Cameron (2008) Strong et al.(2006) and Borquez et al. (2005) are examples of recent publications that informs scholars of how to incorporate ES in existing IS curriculum to meet industry deficit for skilled ES graduates that it so desperately seeks.

**Figure 4**: Comparison of research performed in the year 1996-2000, 2001-2005, 2006-2012

### Future Work

In conclusion this study has identified the established and emerging areas in the ES discipline and identifies gaps in the literature for future research to take place. Further research will be performed into analyzing how important the gaps in the literature are through the interviewing of vendors, consultants, researchers and users. Several limitations that are apparent in the study include that only the articles that were in the journal list specified above were studied and that conferences were not studied. The obvious criticism is directed towards the transferability, dependability and generalizability of the analysis. Not all ES papers are accounted for and made it through our sieve although we argue that examining 198 articles is useful as they provide the first instance for rigor to the archival method. Currently two of the journals (Communications of the Association for Information Systems, and Data Base) that were studied by Estevez and Pastor (2001) and Estevez and Bohorquez (2007) have not been analyzed as access to the journals are still under negotiation. Secondly, to claim that a certain nature of ES research is rapidly emerging or one type is preferred over another is premature and not the authors’ intent. But at this stage preliminary findings inform several new and general topics and how they benchmark against more established research undertaking like (implementation and usage). Our study opens up various opportunities for establishing cumulative knowledge to the discipline. Future research can be directed towards replication across more studies and across different periods and/or phases of ES development, a longitudinal design and further statistical validation, to establish a consolidated view of the direction of the field. The implication of extended analysis for the novice ES researcher is that it provides a summary of published research areas and identifies gaps to identify and develop their study focus. For established researchers, the archival analysis captures insights on areas of research that have reached theoretical saturation and subsequently identify emergent topics.
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