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IDENTIFICATION OF CURRENT KEY TOPICS IN ERP POST-IMPLEMENTATION RESEARCH: A LITERATURE REVIEW CLASSIFICATION FRAMEWORK

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Research in Progress

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Abstract

Enterprise resource planning (ERP) systems enable business operations through IT in basically any mid- to large-size company. In the past, research on ERP systems has focused heavily on their adoption and implementation. However, since implemented and running ERP systems are already omnipresent in most industrialized countries, research has to shift its focus to the post-implementation phase. Consequently, in this paper we prepare the basis for a literature review on ERP post-implementation research. We have synthesized and extended classification schemes from prior ERP- and organizational learning literature by distinguishing the level of exploitation and exploration from a technical, an organizational, and a business perspective. Using this framework as a tool, we will be able to systematize relevant literature and we can identify category-specific and inter-categorical exploitation and exploration activities, which will reveal cross-cutting research issues in ERP post-implementation.

Keywords: Enterprise resource planning (ERP), post-implementation, literature review, classification framework.

1 Introduction

Enterprise resource planning (ERP) systems or enterprise systems have become an extensive area of research in the past. Since the 1990s, organizations have invested in ERP software aiming to improve existing enterprise architecture, to structure business processes, and to reduce the operation of legacy systems that were incompatible with the newly arising requirements (Jacobs and Weston, 2007).

The significant survey articles of Esteves and Pastor (2001), Esteves and Bohorquez (2007) as well as Eden et al. (2014) have structured the research field of ERP as a whole of the years 1997-2000, 2001-2005 as well as 2006-2012. The articles do not focus on a particular topic in ERP research but give a broad overview of ERP research for a certain timeframe structured along the typical phases of an ERP project. They present a comprehensive big picture of the ERP state-of-the-art. They found, that at the time research notably focused on the adoption and implementation of ERP systems, especially investigating critical factors that lead to implementation success (Nah et al., 2003; Umble et al., 2003).

Yet, the market for large-scale ERP systems in the U.S. and Europe is now saturated. ERP systems are widely adopted, used, and essential in organizations. Companies are less concerned with learning about

the introduction of ERP systems, but more about opportunities and risks after the rollout. Research should be, too. Eden et al. (2014) have undertaken a recent survey of the field, concur and state that investigations need to shift towards the phase after the initial go-live, the so-called post-implementation phase. This phase typically starts once normal operation of an ERP system begin, also called usage, endures several transformation cycles, often termed evolution, and lasts until the system is replaced with a new one (Markus and Tanis, 2000). ERP post-implementation research, thus, deals exclusively with topics that are relevant in the use and evolution of these systems within organization *after* an ERP system has been put in place. The customization of ERP systems, financial or social aspects, and implementing interoperability with other systems have evolved as new research topics (Botta-Genoulaz et al., 2005).

However, this post-implementation phase of ERP is still an understudied research topic (Gattiker and Goodhue, 2005; Esteves and Bohorquez, 2007; Grabski et al., 2011; Hecht et al., 2011). While there has been some research, this field has not been comprehensively reviewed and structured yet. In particular, the understanding of complex interrelations between the technical and social dimensions in the use and evolution of ERP systems is still an indistinct area in research and practice. We plan to conduct a literature review to aggregate ERP post-implementation studies from 2006 onwards. We have contemplated also considering older articles. However, the business environment, the expectations of end user as well as technical resources have radically changed in recent years. Hence, if a problem has not been picked up again in this 10-year-frame, it is most likely less relevant than it used to be at the time of publication.

With this research, we aim to derive common areas of investigation to enable scientists identifying future research fields through the identification of research gaps (Eden et al., 2014). For this analysis, we require a classification framework as supportive tool to explain and synthesize the literature. A suitable framework allows us to get a concise view concerning the state-of-the-art of our topic area. To accomplish this, we develop a classification framework for the ERP post-implementation phase taking into consideration factors from the literature reviews introduced above.

In short, the underlying research questions for our analysis to find can be summarized as:

- (a) Which perspectives are relevant for the classification of ERP post-implementation research?
- (b) Which are suitable dimensions to differentiate between operating an ERP system (use) and improving the status quo (evolution)?
- (c) Can these perspectives and dimensions be used to define conceptual clusters of ERP post-implementation research?

To address these questions, we conducted the following tasks:

- (1) Identify a reasonably diverse amount of ERP post-implementation research articles,
- (2) examine these ERP post-implementation articles to learn about researched areas and their scope, and
- (3) build a classification framework based on these initial findings,
- (4) and devise a method to explore inter-categorical research.

Henceforth, this article is structured as follows: First, we present our methodical approach of conducting the literature analysis and performing the classification. Next, we discuss the categorization process and introduce the constructs and model we use. Subsequently, we provide an outlook on our planned analysis to structure the relevant literature along temporal and categorical dimensions as well as in an if-then heat map. The article concludes with a review of the method and a presentation of next research steps.

2   Research methodology

The initial version of our framework was developed using synthesizing the results and findings of prior survey and classification articles in the area of ERP research, namely the works of Esteves and Pastor (2001), Esteves and Bohorquez (2007), Eden et al. (2014) as well as Oseni et al. (2014a; 2014b).

In order to further develop and improve the classification framework, we performed a limited literature review as a pre-test, based on the research framework of vom Brocke et al. (2015). In a first step, we defined the extent of the search. We only included investigations addressing the ERP post-implementation phase following the temporal distinction of Eden et al. (2014). Cf. Figure 1 for this distinction of the ERP lifecycle phases.

Figure 1.   ERP lifecycle phases (cf. Eden et al., 2014)

For this initial overview, we used a keyword search on the leading IS journals, namely the Senior Scholars Basket of Journals, as the outlets under investigation. Using these high quality IS journals as basis for identifying articles induces the diversity inherent in IS research through the rigor of the review process, the composition of the editorial board, and the existence of an international readership and contribution (Hirschheim and Klein, 2012). We also performed a limited forward- and backward search for the confirmed articles to identify additional high quality articles, as recommended by Webster and Watson (2002).

The search process was as follows: Within the journals, we apply a keyword search using the terms 'ERP' or 'enterprise resource planning' or 'enterprise system'. We searched in titles, abstracts, and keywords and received more than 150 hits on ERP research. We screened the resulting papers to only include those that deal with the ERP post-implementation phase. We took our decision in particular based on the phase of ERP lifecycle that was covered in the publication. If we could not make the decision after reading the abstract, we also looked into the introduction and summary. Subsequently, we identify additional articles from further peer-reviewed journals by backward and forward search.

We are aware of the fact that the focus on just eight journals as a starting point leads to a low number of identified papers. However, we consciously decided to restrict the initial set of publications to high quality articles as well as recent papers being cited by them or recent paper building on these strong foundations such as these high-quality articles. We did this to catch current research topics with impact in the IS community rather than the long tail of ERP research which does not display the same relevance and/ or dissemination. Also, we assume that a limited number of 17 relevant papers is sufficient a sample to design a suitable classification framework. As mentioned in the introduction, the plan is to conduct a large comparative review based on more publication outlets later. For more information, cf. the last Section of this paper. It is possible to extend the classification framework during this comprehensive analysis but we do not necessarily intend to do so.

The contribution of this literature review is the procedure of classifying research articles of the ERP post-implementation phase into an evolving typology, which formed during the analysis of the articles. We introduce this classification framework in the subsequent chapter. The analysis of the articles was performed by two researchers, using and extending the distinguishing perspectives and dimensions as presented in Table 2 as the primary basis for decisions to assign an article to one or more of the areas. Suggestions for further categories were noted and discussed.

After an examination of the abstracts, we analyzed the research results or findings sections of papers to examine the research conducted in this paper and its focus. If the general content (abstract, conclusion) of the research articles did not shed light on any addressed categories unambiguously, a paper was analyzed completely. Categories are only devised when the research content had a measurable influence on the research results. For example, Khoo et al. (2011) investigate ways of motivating user participation in maintenance upgrading projects via an in-depth case study using the method of communicative framing. We considered this research on ERP evolution based on the user.

The purpose of this classification activity was not only to determine classification perspectives, topics, and dimensions but to pre-test on a small scale whether the classification schema is (1) exhaustive, (2) understandable, and (3) does not have unnecessary categories. It was not the goal to unambiguously

classify each of the selected articles and already generate quantitative evidence of the status quo of ERP post-implementation research. We understand the framework to be a means to analyze and explain (Gregor, 2006) topics and interconnectedness in ERP post-implementation research.

3 Classification framework for ERP post-implementation research

Most classifications of ERP literature structure their analyses along the phases of an ERP lifecycle. The survey articles of Esteves and Pastor (2001), Esteves and Bohorquez (2007) and Eden et al. (2014) structure and analyze their data in this way. With respect to the more defined focus of our review – i.e. issues in ERP post-implementation – only the usage and evolution phases of the ERP lifecycle with the respective subtopics of use benefits and success, maintenance as well as emerging technologies and integration issues are relevant to our analysis. Hence, we feel that a purely temporal categorization is only of limited explanatory power for identifying research gaps in our literature review.

In order to allow for a less procedural and more multi-facetted view on the topic of ERP post-implementation research, we have developed the following classification framework based on the initial survey of ERP post-implementation literature. It allows to categorize literature into three two-leveled perspectives with two dimensions each. Each article can apply to multiple perspectives and dimensions.

Our classification framework is also informed by the typology of ERP post-implementation modifications by Oseni et al. (2014a; 2014b). The authors have developed a model to analyze organizational motivation in relation to organizational learning and apply it to a resource-based view of processes. In doing so, Oseni et al. (2014a; 2014b) either take the technical or business perspective on organizations.

Since we do not apply our framework to evaluate actual post-implementation modifications in organizations but to classify, structure, and analyze post-implementation ERP literature, we have re-conceptualized the resource-based view into an organizational perspective alongside the technical perspective and the business perspective. Together, they mirror the common research issues of organizational knowledge, ERP product development issues, and business modeling as introduced by Esteves and Pastor (2001). Each of them comprise a number of topics.

The **technical perspective** comprises all system implementation related aspects of post-implementation ERP. This includes evaluations of the system (*system analysis*), modifications of components of the system (*system modification*) or modifications of the interoperability of systems or system components (*system integration and interoperability*). While the outcome of analysis activities may lead to new insights, it does not entail changes in the ERP system. Articles on modification do so. Articles on integration and interoperability often consider the interplay of disparate large systems.

The **organizational perspective** covers all human- and department-related as well as procedural aspects. Here, we distinguish research dealing with the condition and perception of individual workers (*user*) as well as teams (*team*) or the entire organization (*organization*). By doing so, we acknowledge that the relevance and needs of a departmental team and the organization is greater and/ or different from the sum of all its individual employees. Furthermore, we have separated all research on the process organization (*process/ workflow*) from the company's structure. By doing so, we highlight the importance of the procedural organization of work as opposed to the distribution of responsibilities.

The **business perspective** finally summarizes all research that deals with business-related aspects of the ERP post-implementation situation. While most articles have some relation to technical and organizational topics in order to operationalize the realization of winnings or the avoidance of losses, this is not necessarily the case. We have separated all research dealing with the realization of winnings in different dimensions – though not necessarily monetary – (*success/ performance/ value*) from the estimation and management of possible risks (*risk*).

As introduced above, in these three perspectives we distinguish two dimensions for the classification of literature. For this, we have adopted the organizational learning dimensions of **exploitation** and **exploration** also used by Oseni et al. (2014a; 2014b). They mirror the phases of usage and evolution of the

ERP lifecycle. Exploration and exploitation characterize how ambidextrous research is with respect to today and tomorrow. Exploitation in ERP post-implementation research is about analyzing how to use an ERP efficient today given the available resources, while exploration is about investigating evolution opportunities for tomorrow and, thus, creating or adapting new and interesting artifacts.

Table 1 gives an overview of our classification framework. Each of the resulting six distinct areas provides a unique view on ERP post-implementation research. Each of the six areas is – however – usually not tackled exclusively but in a combination of two or more. Hence, it is unlikely that an article can be assigned to only one category. It is more likely that its primary category derives qualitatively from the assigned perspectives and dimensions.

		Exploitation	**Exploration**
Technical	System analysis	Operations & maintenance	Reengineering & technical upgrade
	System modification		
	System integration and interoperability		
Organizational	User	Change management	Reorganization
	Team		
	Organization		
	Process/ workflow		
Business	Success/ performance/ value	Business management	Business innovation
	Risk		

Table 1.   ERP post-implementation research classification framework

The following gives a short overview of the characteristics of each area and provides a short description and an example as well.

Operations & maintenance: System operations and maintenance does not intend to extend the existing ERP implementation, but mirrors all aspects related to routine changes in the working system such as applying patches, support, etc. Without maintenance, a system will fail eventually (Law et al., 2010). Maintenance can facilitate the better application of ERP systems but is unlikely to influence business processes. For example, Nicolaou and Bhattacharya (2006) observe technical changes in ERP systems and relate them to business performance.

Reengineering & technical upgrade: Technical system upgrades introduce new functionality or connectivity into an ERP system. This includes the upgrade to new technologies, the installation of new modules as well as the integration of existing but previously independent systems. These upgrades may have impact on the organization as well as on business (Ng and Gable, 2010). Organizations conduct technical upgrades when there is a need for an enhanced technical infrastructure. As the underlying motive is to update the technical infrastructure, we argue that in the organizational learning context, the resulting innovations are a form of exploration. Lopez and Salmeron (2014) for example propose new maintenance forecasting and simulation methods based on Fuzzy Cognitive Maps.

Change management: Change Management deals with ongoing evaluations and minor adaptations of personal work behavior, the organization as well as business processes to better manage the post-implementation situation. Note that here we use the term change management only for matters that involve people (Castle and Sir, 2001). In organizational learning context, change management is similar to technical maintenance, exemplifying refinements and more efficient organizational agility, and is therefore considered to be a form of exploitation learning. Chang and Chou (2011) for example use surveys to empirically research drivers and effects of ERP learning of users in organizations.

Reorganization: Reorganization encompasses all activities that radically and significantly change the way work is organized or performed. This includes outsourcing of parts of work units as well as pro-

cesses (Hammer and Champy, 1993). Similar to reengineering from a technical perspective, reorganization leads to innovative approaches from an organizational view, which are a form of exploration. Wagner and Newell (2007) for example used interviews and case studies to explore the importance of user participation in ERP post-implementation.

Business management: Business management enhancements modify the way business is conducted similar to system maintenance and change management. Exploitation activities are not technically or organizationally motivated but are a result from analyses relating to risk and/ or success (Nicolaou and Bhattacharya, 2006). For example, Deng and Wang (2014) have empirically coded IT support tickets to analyze business performance with regression models.

Business innovation: Innovation through functional upgrades often precedes all significant technical and organizational exploration activities as they introduce new strategic or tactical business practices. These need then to be reflected in the ERP post-implementation situation technically as well as organizationally (Fryling, 2010). We consider these (planned) changes in the way business is conducted to be exploration activities. Staehr et al. (2012) use process theory to derive a framework for ERP benefits.

It becomes apparent that the respective research approaches are related to the paper being focused on use or evolution of ERP systems. While the former is closely linked to quantitative, empirical research, the latter is represented through more qualitative, conceptual or design research.

Table 2 contains the identified papers, which were used to create the classification framework as well as their classification into the perspectives and dimensions (using e as exploitation and E as exploration).

Author	Journal	Research Method	Technical			Organizational				Business	
			System analysis	System modification	System integration	User	Team	Organization	Process	Success/ performance	Risk
Chang and Chou (2011)	B&IT	Survey				e					
Chou and Chang (2008)	DSS	Survey			e	e			e	e	
Deng and Wang (2014)	JIS	Interview				E			E	e	
Devadoss and Pan (2007)	CAIS	Literature review				E	E				
Gallagher et al. (2012)	JEIM	Survey				E					
Jones et al. (2008)	CAIS	Survey		e		E			e	E	
Khoo et al. (2011)	I&M	Case study		e		E			e		
Liang et al. (2007)	MISQ	Survey				E		e			
Liu et al. (2011)	EJIS	Case study				E		e	e	e	
Lopez and Salmeron (2014)	InfSci	Conceptual	E			e	e	e		E	e
Moalagh and Ravasan (2013)	IJPR	Conceptual			e	e	e			E	
Nicolaou and Bhattacharya (2006)	IJAI	Empirical		e						e	
Pan et al. (2011)	JMTM	Case study	e	e	e	e			e		E
Saraf et al. (2013)	ISJ	Survey				e		e	e		
Staehr et al. (2012)	JAIS	Case study		e		e		e	e	E	
Sykes et al. (2014)	MISQ	Survey		e	e	e	e	e	e		e
Wagner and Newell (2007)	JAIS	Case study				E					

Table 2.   Overview of analyzed articles

4   Application of the classification framework

The application of the classification framework offers several opportunities to derive research-related findings in a contextual and temporal manner. First, the framework allows differentiating between primarily categorical exploration and inter-categorical exploration research. We expect to identify differences between the two research clusters in terms of the quantity of the applied categories.

In addition, the results can be investigated regarding the temporal, category-related aspects. This is going to show the number of assigned articles over time and the most studied clusters in general. Furthermore, the investigation will demonstrate if there are significant changes in the focus of post-implementation literature over time.

In the contextual screening, we are going to analyze the horizontal and vertical allocation of the classified papers. While the horizontal perspective identifies the top-level perspective (organizational exploration/ exploitation, technical exploration/ exploitation and business exploitation/ exploration) the vertical perspective is going to detail the classification of ERP post-implementation research articles into the sub-topics of the three perspectives. The expected results are going to determine the allocation of the research fields regarding to the categories.

A detailed connection/ linkage analysis of the gathered data is going to reveal on the one hand which combinations of topics have been primarily addressed in post-implementation ERP research so far (i.e., e.g., how much research on system analysis has been performed also considering processes). On the other hand, this analysis will also enable us to identify which topics have been under-addressed in post-implementation ERP research. We are going to illustrate how often specific topics have been considered together in one article, and calculate the combined occurrence of topics assignments per paper and sum them up. The table will be a cross-tab with each topic as a column and as a row. Each cell contains the total number of joint occurrence of assignments of the two topics in row and column divided by the total number of assignments (n) of the row only. For example, there may be ten system analysis papers and five papers on processes with four papers of system analysis also dealing with processes. This would entail that in column *system analysis/ processes* the value will be 40 % (4/10) while the value in the cell *process/ system analysis* will be 80 % (4/5). Table 3 will serve as a template for this analysis.

		Technical			Organizational				Business	
		System analysis	System modifica-	System integra-	User	Team	Organi-zation	Process/ workflow	Risk	Success/ perfor-
Technical perspective	System analysis	*n*	%	%	%	%	%	%	%	%
	System modification	%	*n*	%	%	%	%	%	%	%
	System integration	%	%	*n*	%	%	%	%	%	%
Organizational perspective	User	%	%	%	*n*	%	%	%	%	%
	Team	%	%	%	%	*n*	%	%	%	%
	Organization	%	%	%	%	%	*n*	%	%	%
	Process/ workflow	%	%	%	%	%	%	*n*	%	%
Business perspective	Risks	%	%	%	%	%	%	%	*n*	%
	Success/ performance/ value	%	%	%	%	%	%	%	%	*n*

Table 3.   If-then percentage heat map of topics.

While the table is not going to include a distinction between exploitation and exploration, the frequency of jointly examined topics is a suitable measure of research-related interrelation. This overview allows for a straightforward recognition of potential research gaps. The result is primarily a measure of connectedness between the different topics and the direction of this connection. In addition, the results will be discussed and are followed by a specific recommendation concerning the two research questions.

5 Conclusion and future work

In this paper, we have developed and presented a classification framework as well as supportive tools for the analysis of ERP post-implementation research. In answering question (a), we have devised an initial classification framework to distinguish the perspectives of technical, organizational as well as business-centered research in multiple sub-perspectives we call topics. We are further able to separate use and evolution of ERP systems by using the dimensions of exploitation and exploration answering question (b). In answering question (c), we used these perspectives and dimensions to form six clusters of ERP research: Operations & maintenance, reengineering & technical upgrade, change management, reorganization, business management, and business innovation. Furthermore, we have presented a template for the analysis of the inter-categorical research.

Our research contributes to the existing body of knowledge of ERP research by providing a refined and extended classification framework. This classification framework supports structuring ERP post-implementation research contributions and helps to discover dependencies among ERP research topics. While long strand of research has examined ERP research by mainly classifying topics of investigation, ours, to the best of our knowledge, is among the first to additionally recognize interrelations between the topics researched.

Thus, we offer additional insights and expand existing classifications attempts of ERP post-implementation literature reviews. Also, the interrelated perspective on research topics allows a distinctive understanding of quantitative and qualitative or even mix-method-oriented research intentions, by considering ambidexterity through the dimensions of exploitation and exploration. Hence, the results will offer new possibilities of interpreting research gaps in a more holistic manner and provide scholars a more abstract, content independently perspective of ERP post-implementation enquiries.

Based on this framework, we will conduct a comprehensive literature review on post-implementation ERP research to better understand the current key topics discussed in ERP post-implementation research and to identify corresponding research gaps. In order to gather a comprehensive picture of the current state-of-the-art in ERP post-implementation research, we will widen the search to include the outlets identified as relevant ERP-literature outlets identified by Eden et al. (2014). In doing so, we may need to specialize the keywords to include the like of "post-implementation" to receive less false positives. We will search in titles, abstracts, and keywords. Again, we may identify additional articles from further peer-reviewed journals by backward and forward search. In detail, we are going to explore the temporal distribution of articles and we will show how IS research deals with the interaction of organizational, technological, and business-related ERP issues in an exploitative and explorative manner.

In short, the underlying research questions for our future analysis can be outlined as follows:

(a) What are the trends and patterns of ERP post-implementation research observed for the period of 2006 onwards?

(b) What are prominent topics (perspectives) in ERP research? Which of these are examined more in relation to the use (exploitation) of ERP systems and which are examined more in in relation to the evolution (exploration) of ERP systems?

(c) What are the gaps in ERP post-implementation research that should be addressed in a more explorative respectively exploitative manner?

(d) Which links between perspectives of ERP post-implementation research can be observed? Does the analysis also expose gaps in these linkages?

To address these questions, we will conduct the following tasks:

(1) Identify relevant high-impact research articles in quality research outlets for ERP research,

(2) examine these ERP post-implementation articles to learn researched areas, organized through our classification framework, and

(3) quantify clusters of ongoing research, which may point out well covered areas as well lack of research, and, thus, opportunities for future research.

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