

Enterprise Resource Planning contribution to firm performance: A literature review over the last 15 years

PHILIPPE MANGIN¹, VINCENT HOVELAQUE², LAURENT BIRONNEAU³

IGR-IAE de Rennes
Université de Rennes 1, CREM UMR CNRS 6211,
11 rue Jean Macé - CS 70803
35708 Rennes Cedex 7
FRANCE

¹ philippe.mangin@univ-rennes1.fr, ² vincent.hovelaque@univ-rennes1.fr, ³ laurent.bironneau@univ-rennes1.fr

Résumé – Cet article présente l'état de l'art académique sur la contribution des ERP à la performance des entreprises. Une revue de littérature sur la période 1999 à 2014 a permis l'analyse systématique de 54 publications. Parmi les principaux résultats, il apparaît que la mise en œuvre d'un ERP a un impact globalement positif sur la performance des grandes entreprises, et ce particulièrement après plusieurs années, et de façon plus marquée sur la performance non financière. Pour ce qui est des PME pour lesquelles les ERP sont déployés plus récemment, la contribution reste à démontrer. Deux grands axes de recherches futures sont mis en exergue : (1) proposer un système de mesure de performance liée à l'ERP, complet et opérationnel ; (2) conduire des études utilisant des modèles d'analyse élaborés, considérant la performance de façon multidimensionnelle, et ce particulièrement dans le secteur des PME ou dans le secteur public.

Abstract - This present paper proposes to give the current point of view of academics regarding the contribution of ERP on business performance, at the firm level. A literature review covering the period of 1999 to 2014 has resulted in a systematic analysis of these 54 contributions. As main results, ERP implementation on major companies have globally a positive impact, especially on a long period of time, even if it's most notable on non-financial dimension. On the other hand, due to the fact that ES are more recently deployed in SMEs, the contribution is still to be demonstrated for smaller organization. Two main research avenues have been highlighted through this review: (1) The development of a comprehensive and practical performance measures for ERP systems; (2) Complete performance assessment studies, with elaborate model, using multidimensional measures, giving new perspectives on ERP contribution to firm performance, especially on SMEs and public sector organizations.

Mots clés – Post implémentation, contribution et bénéfices des ERP, mesure de performance, revue de littérature

Keywords - Post implementation, ERP value and benefits, performance measurement, literature review

1 INTRODUCTION

For more than two decades, Entreprise Systems (ES), also called Entreprise Ressource Planning (ERP), have been implemented in many companies to support key processes, like finance and accounting, production, supply chain and distribution, material management, sales and marketing, human resource or quality management [Romney, M.B. and Steinbart, P.J., 2012]. ERP are now a well-known concept, either for academics or professional: “They are now widely adopted by organizations and have become the backbone of IT business management.” [El Amrami and St Leger, 2013]. Moreover, the level of investment for an ERP implementation is often considered as a strategic level, often quoted in millions of dollars [Poston and Grabski, 2001 ; Falk, 2005 ; Liu et al., 2008 ; Deltour et al., 2014 ; survey from Panorama Consulting, 2014]. From a US study made out of 482 companies of various size in 2000, Mabert et al. [2003]. reported an average implementation cost ranged between 1,5% and 6% of the annual revenues. Quoting Behesti et al. [2010], “ERP systems are expensive, complex, and take a relatively long time to

implement”. For all that reasons, ES contribution to the company's performance is a major motivation for the decider who analyzes a future ERP project. Another key point strengthens the interest of assessing benefits out of ERP: “It is difficult to abandon the ERP systems once the old legacy systems have been replaced” [Hsu L. and Chen M., 2004].

Based on these observations, this present paper proposes to give the current point of view of academics regarding the contribution of ERP on business performance, at the firm level. Critical starting point to any research project, especially in the field of Information Systems [Webster J. et al., 2002], a literature review covering the period of 1999 to 2014 has resulted in a systematic analysis of these contributions. 54 papers on ERP contribution to firm performance published in academic reviews or conferences have been in deep analyzed, answering the following research questions: What is the state of art regarding ERP contribution to firm performance produced by academic searchers? Out of this review, what are the main results on which the academic corpus can rely on? What would be the main practical implications and future research opportunities?

To go through these questions, the article is divided into four remaining sections. Section 2 presents the methodology for this literature review. Section 3 provides an overview of the articles reviewed, key findings will be synthesized. The in deep analysis and key findings are then provided in section 4. Finally, section 5 proposes some opportunities for future research, discussion and general conclusion.

2 RESEARCH METHODOLOGY

In 2002, the information systems (IS) field suffered from “few published review articles. As a result, the progress of our field” [Webster et al., 2002] was impeded. In that context, Jane Webster (Queen’s School of Business, Canada) and Richard T. Watson (Terry College of Business, Georgia, USA) wrote an article in the prestigious MIS Quarterly (Vol. 26 No. 2, pp. xiii-xxiii/June 2002) called : Analyzing the past to prepare for the future : Writing a literature review. Since then, this article is often quoted [Schlichter B.R. et al., 2010; Haddara M. and Zach O., 2012; El Amrani R. and Saint-Léger G., 2013] as a reference basis to go through this state of art. In a Systematic Review of Literature (SLR), the current publication is going through a five step process, following Webster et al. [2002] method.

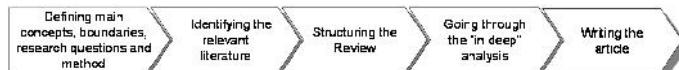


Figure 1 – A five step method for the SLR - Adapted from Webster et al. (2002)

The first step is covered through the introduction, steps two and three will be developed hereafter, while step four and five are the main topic of the article.

2.1 Identifying the relevant literature

First of all, the time boundaries of the review had to be defined. As ERP (Enterprise Resource Planning) is quite a new concept introduced in 1990 by the Gartner Group [Mabert V.A. et al., 2001], an American company specialized in technologies market analysis, the post implementation phase and the benefits expected from ERP are studied only from 1999. To the best of our knowledge, the first two articles are published then. In August 1999, Jeanne W. Roos wrote a working paper from the Center for Information Systems Research of the prestigious Sloan School of Management (MIT), called “The ERP Revolution: Surviving Versus Thriving”. Based on a survey involving 15 firms, made in 1998 with 3 phone calls by companies, the main results are the following: Twelve months after the Go Live, 50% had overpassed the stabilization period and “these firms were starting to generate significant operating benefits”. The main value quoted by the author is inventory reduction or inventory turn improvement, service level or OTIF indicator leverage, and costs downsizing. For the last 50% questioned, the conclusion was already: “It is not clear how many firms that have or are implementing ERPs will actually achieve the benefits”. Then the next time limit selected for the current study is 2014, while the first search were made January 2015.

Then we defined key words linked to the main topic, ERP contribution to firm performance, in order to look “by topic across all relevant journals” and conferences [Webster et al., 2002]. To do so, previous literature review on ERP fields were studied [Botta-Genoulaz V. et al., 2005; Moon Y., 2007; Esteves J and

Bohorquez V., 2007; Schlichter B.R. et al., 2010; Grabski S.V. et al., 2011; Haddara M. and Zach O., 2012; El Amrani R. and Saint-Léger G., 2013], defining more precisely common used words on our study. Thus, Schlichter et al., [2010], defined a “conceptual framework for areas of concern regarding ERP systems”, with 8 major topics. As defined, this article objective refers to “post implementation”, “value and benefits”. Al-Mashari M., 2002, proposed a research agenda on ERP systems. Going through its taxonomy, “performance measurement”, “ERP” and “literature review” were added to our key words. All combination of those were used, mainly on internet source and three databases: The Google Scholar tool, Business Source Complete EBSCO database, Elsevier Science Direct database.

The queries and previous literature review led on a first selection of 38 articles. The in deep analysis of these articles and their references are also an opportunity to identify 10 other articles on the research field. An article cloth to our investigation [Ruivo P., et al., 2013] gave us the final list of 54 publications, from academic journals or conferences between 1999 and 2014 (see references in 6.2).

At least, some articles cloth to the study, but not given results on the ERP contribution to the firm performance were removed from the selection. After selecting the 54 relevant publications from 1999 to 2014, the analysis had to be prepared (Step 3 of the methodology) and it's the subject of the next subsection.

2.2 Structuring the Review

“A literature review is concept-centric. Thus, concepts determine the organizing framework of a review” [Webster et al., 2002]. Beyond usual criteria for description of an academic publication (author, date, title, name of the journal or conference ...), reading of articles brought key concepts that structures the analysis and then leads to findings.

Even if “financial results still hold a prominent place in evaluating business performance” [Cauvin E. and Bescos P.L., 2005], this concept has to be assessed through a larger prism, as suggested by many authors during the last two decades [Kaplan R.S. and Norton D.P., 1996; Oltley D., 1999; St Pierre J. et al., 2005]. The first key of analysis is the nature of performance measurement. Regarding all studies made between 1999 and 2014, another interesting criteria is the methodology employed to link ERP system and performance in a causal effect relation (qualitative vs. quantitative methods, statistical methods, etc.). Looking for the theory supporting the articles is also a valuable information, as far as “the lack of theoretical progress in the IS field” [Webster et al., 2002] is a recurrent topic in the IT literature. The size of the firm is also an entry point used by researchers [Sedera D. et al., 2003]. Regarding the question addressed by the publication, an overall indicator on the answer delivered by the authors is also interesting: A three level assessment will be operated. A positive contribution of ERP on firm performance is clearly demonstrated (+), on the opposite hand, a negative contribution will be reported as (-), and a more nuanced answer as (/) symbol, benefits are not clearly demonstrated, depends on factors not clearly identified, or are contrasted (some variables are positively correlated to performance, some negatively, some are non-significant variables). As far as “business performance is a multi-faceted concept” [Neely A., 1999], a systematic analysis of performance indicators used will be covered, giving a kind of taxonomy. The articles are reviewed one by one, each KPI are listed, and the contribution is reported in Excel matrix, one for financial

evaluation, one for operational and organizational performance and a third for mix analysis. Out of this in deep analysis, two major contributions are expected: (1) We aim to conclude if a standard framework to assess ERP contribution to firm performance is emerging, or, on the other hand, if the studies are using exploring approach without any link. (2) Based on this review, major trends on the causal link between ERP and business performance will be synthesized. This will be developed in Section 4.

Out of these concepts or criteria, a matrix has been built in order to ease the analysis, and the synthesis of author's point of view. This method next facilitates all statistical treatment on the collected data. All the information got from the publication are thus organized into a database. The main investigation made out of this database are statistics based on the criteria describes above. We now present the overview of the 54 articles, analyzed in deep, through publications and journals from which articles come, having a time perspective analysis, giving a world map view and to finish with, research method, theory or framework used.

3 OVERVIEW OF THE ARTICLES

3.1 Publications and journals

54 publications were reviewed: 41 journal articles, 10 conference proceedings, 2 working papers and one book. The book called *Mission Critical: Realizing the promise from enterprise systems* [Davenport T. H., 2000] is a reference into the ERP research (more than one thousand quotations on Google Scholar beginning of 2015).

Going into the journal publications, the next table 1 presents an overview sorted by the main categories from management field (from Comité National de la Recherche Scientifique, CNRS, Section 37, Economics and Management, France, 2014), and the number of items.

Even if the IS field is mainly represented (almost 50% of the articles), 30 % concerns Production, Operation management and Industrial organization, 16% in accounting, auditing or finance. Two papers are in the general management field (The International Journal of Management Science) or in the Operational Research (European Journal of Operational Research). This finding is consistent with previous literature review [Wieder B. et al., 2006; El Amrani R. and Saint-Léger G., 2013], the question of ERP in academic works is a transversal topic, across several management fields. This fact is all the more true when looking on performance out of Enterprise Systems, as far as the causes generating business value are wide and multiple.

Table 1 – Publications by main categories from management field

Code* Category	Categorization of Journals*	Number of publications	%
SI	Management Information Systems	20	49%
LOG	Production and Operations Management	8	20%
Orgind	Industrial Organization	5	12%
CPT	Accounting and Auditing	5	12%
FIN	Finance and Insurance	1	2%
GEN	General Economics, General Management	1	2%
RO	Operations Research	1	2%
Total		41	100%

* : Categorization of Journals in Economics and Management (from the french CNRS classification, section 37)

Out of 41 articles, 30 journals have published on that topic; none of it have a real focus on ERP post implementation and its benefits, except for the International Journal of Accounting Information Systems which have four articles on this subject (whose two are major publications, Poston and Grabski 2001; Hunton et al. 2003, with respectively 438 and 370 on Google Scholar quotations at the end of march 2015). This is not surprising, as far this journal “publish thoughtful, well developed articles that examine the rapidly evolving relationship between accounting and information technology”-Editor’s web site, consulted March the 27th, 2015. Indeed, performance analysis is one of the core research avenue in the accounting field [Grabski S. et al., 2011]. Out of the list of journal, five outstanding publications have been pointed (Journal of Operations Management, Production and Operations Management, European Journal of Operational Research, MIS Quarterly, Journal of Information Technology). Nevertheless, none of it have recent articles (from 2000 to 2007).

Going back on the conference relating ERP contribution on firm performance, nine out of the 10 events are clearly focused on Information Systems, only one is on strategic management. ERP contribution to firm performance is a subject of interest mentioned regularly from 2000, the last one was in 2012 at the 6th ECIME conference.

3.2 Over the last 15 years ...

Looking at the time dimension, the first article related to subject of the review is published in 1999 (see subsection 2.1). From then, three publications on average are made every year, up to six in 2005. It discloses a small, but regular interest in ERP value during the post implementation stage.

An interesting way of looking at this trend is to add the size of firms as a new analysis factor. The figure bellow presents publication’s frequency, distinguishing major companies and miscellaneous (one study is on public sector), and Small and Medium Enterprise.

Looking in deep to this figures, the increase interest on SME for analysis the contribution of ERP to performance during the last four years (2011 to 2014) is clearly shown in table 2 (next page). Indeed, 50% of articles are related to SME, compared to a 15% from 1999 to 2010. Except one case study early in 2000 [Marsch AM., 2000], interest for ERP value started in 2006 and 2007 [Equey Balzli C., 2006; Shin I., 2006; Federici T., 2009]. This trend can be directly linked to the way the ERP market has been addressed by software editors. “Due to the close-to-saturation of

Table 2 – Number of publications per year, by firm sizes – data

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	TOTAL
Major / Miscellaneous	2	2	1	4	4	4	6	3	3	4	0	3	3	1	1	1	42
SME	0	1	0	0	0	0	0	2	0	1	2	0	2	2	1	1	12
Globally - all companies	2	3	1	4	4	4	6	5	3	5	2	3	5	3	2	2	54

Sort based on author's citation in articles

ERP adoptions in large enterprises (LEs), ERP vendors now focus more on SMEs". [Haddara M. and Zach O., 2012].

3.3 Research method, theory or framework used

Table 3 below gives an overview of the type of method used.

Table 3 – Method used in publications

Method type	Detail of the methodology	Number of articles	% by method type
Qualitative	Case study	12	26%
	Literature review	1	
	Phenomenal interviews	1	
Quantitative	No detail given	1	72%
	Descriptive statistics, correlation or regression	31	
	Structural Equation Modeling (SEM), using Partial Least Square (PLS)	7	
Mix - Qualitative & quantitative	Case study, Descriptive statistics, correlation (ANOVA)	1	2%
	Total	54	100%

On the one hand, the quantitative method, using a questionnaire survey on a target population, are mainly represented with 72% of the articles, results cloth to Ruivo P. et al., 2013 in their literature review (78,8% of survey), and confirmed by Mabert VA et al., 2003 : "Surveys have been extensively used for research. In the Operations Management area, there is a strong tradition for using this methodology".

The results provided out of surveys mainly come through basic statistic methods, correlations or regression models (57%). Quite recent publications, between 2008 and 2014 mention the Structural Equation Modeling (SEM) methodology, specifically using Partial Least Square (PLS) (13%). As far as "it is difficult to assess moreover quantify the benefits and returns on investment, even more difficult to determine the share of ERP in improving performance overall business" [El Amrani et al., 2013], we wonder why SEM/PLS method are not more used in publications studied. Indeed, quoted by Fernandez V. [2012] and Jöreskog and Wold [1982] describe the method as "adapted to predictive causal analysis in situations of high complexity and low theoretical information", or a "modeling methods adapted to define complex interacting systems" [Jakobowicz E., 2007]. Evaluating ERP contribution to firm performance is a causal effect problem, with a great number of parameters involved. This can lead to complex models, based on 6 constructs, 13 hypothesis to test and up to 30 measures to assess financial and non-financial performance [Kallunki JP. et al., 2008]. Comparing the seven PLS models described in the articles and other models based on basic statistical models, the difference is the type (second order, with latent variables; Yan Zhu et al., 2010) and the number of constructs (between 3 and up to 6), and finally the number of associated items (up to 30, see above quotation). Again, regarding the PLS method prerequisites, the choice seems to be relevant, and could be a recommendation for future research.

On the other hand, main qualitative analysis (26%) are based on case study, often justify by many authors [Rougès J.F. et al., 2010; Uwizeyemungu S. and Raymond L., 2010; Zach O., 2011] as a good method "for explanations of causal links within phenomena that are too complex for survey or experimental research strategies" [Yin, R. K., 2003].

Ultimately, only one publication is reported as using both qualitative and quantitative method [Mabert VA. et al., 2003]. Authors used a case study on 12 different manufacturing ERP implementations, defining first results and method. Based on it, and to confirm initial findings, a second phase conducted out of a questionnaire survey, sent to 5 000 APICS members employed in manufacturing companies in the US in August 1999. 482 usable responses led to the following conclusions: "The benefits differ by company size. Larger companies report improvements in financial measures whereas smaller companies report better performance in manufacturing and logistics". Even this two-step process can be understood as a long and time consuming process often used in doctoral / PhD studies, it gives a great opportunity to validate constructs and associated items on a small panel before going into a large scale survey, with the risk of unusable data at the end. Looking in deep at the methodological aspect of publications, the main finding is the absence of theory emerging out of the review. Almost 50% of the publications are not mentioning any theory or framework behind their conclusions, 20% are using standard financial ratio, and the Cobb-Douglas production function is quoted four times for productivity studies. Three publications [Ruivo et al., 2012, 2014 ; Johansson B. et al., 2012] are supported by the Resource-Based View (RBV) theory, linking performance results (called ERP value) to the way the ERP is implemented (ERP use). Other articles are quoted other studies [Brynjolfsson and Yang model, Doll and Torkzadeh instrument, Tracey et al., Bhattacharya model, Mabert et al., Hitt, Wu and Zhu model, Stefanou, Jacobs and Bendoly, Olhager and Seldin, Gattiker and Goodhue, Gable et al.], by taking all or part of the methodology used by these authors. This result is consistent with recent studies [Staehr L. et al., 2012] working on conceptual framework for ERP benefits assessment. "We indicated a lack of guidelines that can be used to identify, realize and assess benefits." [Eckartz S. et al., 2009].

If assessing firm performance, the first step is to give a definition. This can rapidly become a difficult task, regarding the fact that it's "a polysemic or multifaceted concept that can have several meanings according to its author or assessor" [Saint-Pierre J. et al., 2005], also subject to change over time (From the DuPont model based on ROI – first half of the XXth century to the concept of Corporate Social Performance leading by Sustainable Development movement now, even if considered a "mobilizing utopia" [Capron M., Quairel F., 2006], passing by Economic Value Added-EVA [Stern et al., 1998] and Balanced Score Card – BSC [Kaplan R.S. and Norton D.P., 1993, 1996] from 1990 to 2000, concepts are considering the firm perform as a more global issue). Thus, "performance per se may not be definable in the absolute" [Lebas M.L., 1995]. Regarding the literature on ERP benefits taxonomy, the main common framework is the Shang and Seddon, 2002. Even if quoted only by two authors in our SLR [B. Snider et al., 2009; I. De Loo et al., 2013], this model, completed by the financial dimension, allows to synthesize all the indicators used in the 54 publications (See Table 4).

We then used five basic dimensions deducted from Shang and Seddon - 2002, to classify all articles:

Table 4 - Performance benefit type, inspired from Shang and Seddon ERP benefits assessment framework, 2002

Nº	Performance benefit type	Code used in the following section
1	Operational benefits (which include the IT structure in the Shang & Seddon model - SSM, Business Process improvement and Manufacturing flexibility which are not explicitly reported in SSM)	OP
2	Managerial benefits	MGT
3	Strategic benefits	STR
4	Organizational benefits	ORG
5	Financial benefits	FI

The next section will now go in deep into the main results, answering the research question: What is the state of art regarding ERP contribution to firm performance produced by academic searchers?

4 ANALYSIS AND MAIN RESULTS

First of all, an overview of articles will be given, sorted by performance dimension assessed. Then, the main results of the 54 publications will be presented by performance dimension in three subsections:

- All financial studies (15 articles),
- The non-financial dimensions (35)
- Mixed dimensions (the last 4).

The following table (see next page, table 5) presents all publications within a two dimensions prism, performance assessed by the authors and company size.

As often observed, “performance measurements for enterprises have traditionally measured performance financially” [Yi-Hui Liang, 2015]. This trend is also right when assessing ERP contribution. 28% of the publications are using standard financial metrics. A major common point out of these 15 financial studies is the public data, as opposed to data collected from a survey. Ten of these are made on the American field, using the Lexis/Nexis Newswires database, the Standard and Poor’s Compustat II database, the Dow Jones News Service or the Wall Street Journal. On the other hand, they are very few articles assessing in a same model, financial and non-financial dimensions, four contributions only (less than 10%): Wieder et al. [2006], followed by Kallunki et al. [2008], Tsai et al. [2011] and more recently Galy and Saucedo [2014]. To ease access to data - often considered as confidential by executives [Law and Ngai, 2007] - a Licker scale is used to get operational measure of financial constructs, apart from Galy and Saucedo gathering the financial ratios from Standard and Poor’s Compustat Database and Thompson Reuters’ DataStream for 55 US companies.

Operational dimension, also combined with the Organizational one are equally represented with 12 publications or 22%. As “success in the ERP experience is multidimensional”, a remarkable point is the few articles assessing more than 3 performance dimensions (only 10). Maybe this point is could be explained by the assertion given by Markus et al. [2000], in the same sentence, because it’s “often hard to measure”.

Looking in deep on studied made on SMEs with a wide prism of performance, 3 of it have been conducted on the same model (Ruivo et al., 2012, 2014; Johansson B. et al., 2012, already quoted in page 14), and one case study conducted by Snider B. et al. in 2009 resulting in contrasted result, adding the fact that “as with other qualitative research, this study has limitations that

might constrain the generalizability or validity of findings”. “While Top Fortune 500 businesses and multinational organizations initially adopted ERP, small- to medium-sized businesses (SMBs) around the world are now implementing this software.” [Galy E. and Saucedo M.J., 2014]. A research using a survey on a large panel of SMEs, assessing performance with multidimensional approach could then be useful to lighten ERP contribution to SMEs performance.

Two other findings are coming out of this overview. First, the Strategic dimension of performance is scarcely investigated [Mc Afee A., 2002; Kallunki et al., 2008; Snider B. et al., 2009], even if the strategic dimension (Support business growth, Generating product differentiation, Building cost leadership, Building business innovation...) of an ERP implementation for a company have academic evidence [Mourrain A., 2007; Deltour et al., 2014]. This dimension involves a long term commitment, which, by essence, difficult to assess through an academic survey. Secondly, only one study has been found regarding ERP contribution to performance into the public sector. Yet, SAP, the current ERP editor leader, has invested in this field, particularly in healthcare organizations and university hospitals (SAP for healthcare 2010, quoted by Beheshti et al., 2010). Again, a study involving a large spectrum of public organization could increase the body of knowledge for researchers working on ERP post implementation issues.

4.1 Financial dimension, overall results:

The following table (Table 6) resumes the main results out of the 15 articles assessing directly financial performance out of ERP implementation.

Table 6 – ERP contribution on firm performance, assessed with financial dimensions

	ERP contribution on firm performance ... Financial dimensions				TOTAL	%
	-	/	+	8		
Major Enterprises	1 Liu et al., 2008	4 Poston & Grabski , 2001 ; O. Velicu , 2005 ; Hendricks & al. , 2007 ; M Anderson & al. , 2011		Hitt & al. , 2002 ; Hunton & el. , 2003 ; Nicolaou A. , 2004 ; Matolcsy & al. , 2005 ; Nicolaou & Bhattacharya , 2006 ; B. Dehning & al. , 2007 ; Romero & al. , 2010	13	87%
Small & Medium Enterprises	1 Bohorquez V. & Esteves J., 2008	1 Shin I. , 2006			2	13%
All size					0	0%
Public Sector					0	0%
TOTAL	2	5	8	15	100%	
%	13%	33%	53%		100%	

The first well-known study was made in 2001 by Poston and Grabski, after a decade of project implementation, mainly in major companies. A basic model with descriptive statistics and correlation linking ERP System Architecture and finance return was used. Based on four metrics, an expense ratio measured by the Cost of Good Sales under the firm revenue and the Labor Productivity (LP) defined as Sales under number of employee were positively correlated with ERP projects, while Selling, General and Administrative costs over Sales and Residual Income (RI), defined as net operating income less “imputed” interest [Horngren et al., 1999] were not. For the first study, the main conclusion was: “The 3-year longitudinal window may be insufficient to capture the effects of ERP on firm performance”. Based on the following, other studies followed extended with a time parameter (Figure 18), giving positive results on major companies [Hunton et al., 2003; Nicolaou, 2004].

Table 5 – Overview of articles reviewed – Performance assessed, Company size

Performance dimension assessed	Major Enterprises	Small & Medium Entreprises	All size	Public Sector	TOTAL	%
FI	14 Poston & Grabski , 2001 ; Hitt & al , 2002 ; Hurton & al , 2003 ; Nicolaou A , 2004 ; Matolcsy & al , 2005 ; O. Velcu , 2005 ; S. Aral & al , 2005 ; Nicolaou & Bhattacharya , 2006 ; B. Dehning & al , 2007 ; Hendricks & al , 2007 ; Liu & al , 2008 ; Romero & al , 2010 ; M Anderson & al , 2011	2 Shin I. , 2006 ; Bohorquez V. & Esteves J. , 2008			15	28%
OP	5 Markus & al , 2000 ; D. Lombard , 2002 ; Hawking & al , 2004 ; Y. Yusuf & al , 2004 ; Kang, Park, Yang , 2008	3 AM Marsch , 2000 ; Haddara & Päiväranta , 2011 ; Ondrej Zach , 2011	4 R. Canonne & JL Damret , 2002 ; M. Falk , 2005 ; A. Madapusi , D. D'Souza , 2012 ; Ram & al , 2013		12	22%
OP & ORG	5 Fryer B. , 1999 ; Daverport, T.H. , 2000 ; Ohlager J. & Seldin E. , 2003 ; Gattiker & Goodhue , 2005 ; Law & Ngai , 2007	2 Equy Balzzi C. , 2006 ; I. De Loo & al , 2013	4 VA Mabert & al , 2003 ; Gefen D. & Ragowsky A. , 2005 ; Chou S.W. & Chang Y.C. , 2008 ; Beheshti H.M. & Beheshti C.M. , 2010	1 D. Sedera & al , 2003	12	22%
OP, ORG & MGT	3 Li-Ling Hsu & Minder Chen , 2004 ; Chaabouni A. , 2006 ; Jalal A. , 2011	3 Ruivo P. & al , 2012 ; Johansson B. & al , 2012 ; Ruivo P. & al , 2014			6	11%
OP & MGT	2 Ross J.W. , 1999 ; Yan Zhu & al , 2010	1 T. Federici , 2009			3	6%
OP & STR	1 Mc Afee A. , 2002				1	2%
OP, ORG, MGT & STR		1 Snider B. & al. , 2009			1	2%
FI & OP	1 Wieder & al , 2006				1	2%
FI, OP & ORG	1 Tsai M-T. & al , 2011				1	2%
FI, ORG & MGT	1 Galy E. , Sauceda M.J. , 2014				1	2%
FI, OP, ORG & STR	1 Kallunki & al , 2008				1	2%
TOTAL	33	12	8	1	54	100%
%	61%	22%	15%	2%	100%	

Out of these, a major finding was the minimum time lag, between two and three years, in order to get results, noting even sometimes an underperformance during the year following the GoLive (also confirmed by Markus et al. regarding operational performance). Shin I. [2006] demonstrated a very slight increased (+1,79% in average) on the Total Productivity factor, as regard to the Cobb-Douglas productivity measurement, on South Korean SMEs. More than 50% of studies are demonstrating a positive correlation between ERP implementation and financial performance, using classical financial metrics.

Like Matolcsy et al.[2005], Velcu [2005], Anderson M. et al. [2011], the method using a control population that has not implemented an ERP solution seems to be robust, allowing also to detect environmental effect on specific market.

Others studies led to more contrasted results, like Velcu, [2005], findings only positive contributions on 2 indicators ("the successful implementation ERP systems lead to a significantly superior efficiency in utilizing assets and capital") out of 6, or Anderson et al. [2011], who gave some positive evidence on 2 metrics (Fixed Asset Turnover and Return On Sales), out of 8, on a short sample of major firms in Oil and Gas industry. On the other

hand, Liu et al. [2008] find "no significant performance improvement during the implementation period and the three-year post-implementation period and a decline in performance in the first two years after implementation", in major company context, while Bohorquez V. and Esteves J. [2008] concluded that "ERP implementation and use affects negatively SMEs productivity". These first contrasted results trying to link ERP and financial performance are consistent with many authors quoted doubts in financial perspectives [Canonne et al., 2002; Chaabouni, 2006; H.M. Beheshti and C. M. Beheshti , 2010].

4.2 Non-financial dimensions, overall results

Table 7 (beginning of next page) summarizes the attainments out of the 35 publications dealing with the non-financial dimensions of performance, ie operational, managerial, strategic or organizational.

A clear majority of more than two third (69%) of the publications is reported a positive contribution of ERP on business process performance, defined as Dehning B. and Richardson V.J. [2002].

Table 7 – ERP contribution on firm performance, non-financial dimensions

ERP contribution on firm performance ... Non financial dimensions					
	-	/	+	TOTAL	%
Major Enterprises	1 Hawking & al., 2004	3 JW Ross , 1999 ; Markus & al. , 2000 ; Akram Jalal , 2011	12 Bronwyn Fryer , 1999 ; Thomas H. DAVENPORT , 2000 ; A. McAfee , 2002 ; D. Lombard , 2002 ; J. Olhager, E. Seldin , 2003 ; Y. Yusuf & al. , 2004 ; Li-Ling Hsu & Minder Chen , 2004 ; Gattiker & Goodhue , 2005 ; Amel CHAABOUNI 2006 ; Law & Ngai , 2007 ; Kang, Park, Yang , 2008 ; Yan Zhu & al. , 2010	16	46%
Small & Medium Enterprises		2 B. Snider & al. , 2009 ; Haddara & Páivárinta , 2011 ;	8 AM Marsch , 2000 ; Equy Balzi C. , 2006 ; T. Fedencic , 2009 ; Ondrej Zoch , 2011 ; Pedro Ruivo & al. , 2012 ; B. Johansson & al. , 2012 ; I. De Loo & al. , 2013 ; Pedro Ruivo & al. , 2014	10	29%
All size		5 R. Canonne & JL. Damret , 2002 ; Gefen D. & Ragowsky A. , 2005 ; S.W. Chou , Y.C. Chang , 2008 ; A. Madapusi, D. D'Souza , 2012 ; Ram & al. , 2013	3 Mabert VA. & al. , 2003 ; Falk M. , 2005 ; Beheshti H.M. & Beheshti C. M. , 2010	8	23%
Public Sector			1 D. Sedera & al. , 2003	1	3%
TOTAL	1	10	24	35	100%
%	3%	29%	69%	100%	

Only one study made by Hawking et al. [2004], on a population of 48 Australian companies implementing SAP between 1995 and 2002 reports a clear negative contribution on 12 operational performance indicators: "None of the benefits were realized to the expected level". The main explanation is given by the companies themselves: "they [Australian companies] still consider change management issues impacted on the success and benefit attainment." Earlier in 1999, even if reporting 11 tangible benefits and 7 "Lovely intangible" benefits from an ERP program after going live, Bronwing Fryer warned : "Change management and training may be the biggest obstacles to achieving benefits from an ERP system". Ten studies are presenting contrasted results. "It is not clear how many firms that have or are implementing ERPs will actually achieve the benefits." [Ross J.W., 1999]. Canonne et al. reports clear benefits on Information & data quality, and on Availability (59%), transmission speed (46%), while cost reduction (operating or IT) is scarcely quoted as a benefit (less than 10%): "Cost reduction can't be the first objective from ERP implementation". Meanwhile, Chou S.W. and Chang S.W. [2008], are linking ERP contribution to alignment between ERP project goals and firm strategy: "The acquisition of ERP benefits is not automatically even after a firm has implemented ERP successfully at the initiation and adoption stage". Gefen D. and Ragowsky A. [2005] suggested another vision of current difficulty to assess ERP contribution: "Positive returns from investing in IT may not have shown up in previous research because of the inadequate way it was measured", and then gave a new look on this issue: "The benefits gained by ERP systems will be better predicted by being measured separately at the level of activity areas within the organization, rather than at the broad level of the entire ERP system". Taking into account business characteristics at specific module of ERP, or specific function (Customer Order management, Suppliers & Purchase Orders module for instance in their study), it explains around 40% percent of the variance in the assessed values of the ERP system. Ram et al., 2013 explained a cause effect relation using an elaborate PLS model between ERP contribution on operational performance and System Integration (SI) & Training and EDucation (TED) of ERP users, joining change manage key point on the last variable. Finally, Beheshti H.M. and Beheshti C. M. [2010], mention the lack of top

management commitment considered as a major reason for an unsuccessful implementation. Thus, this key success factor should be considered in future study.

4.3 Global studies mixing all performance dimensions

To finish the overview of publication's conclusion regarding ERP contribution to firm performance, only four quiet recent studies have a broad vision of company's attainments, measuring on a same population financial and non-financial variables (Table 8).

Table 8 - ERP contribution on firm performance, multidimensional assessment

ERP contribution on firm performance ... Financial & non financial dimensions					
	-	/	+	TOTAL	%
Major Enterprises	1 Wieder & al., 2006	1 Tsai M-T. & al. , 2011	2 Kallunki & al. , 2008 ; Galy E. & Saucedo M.J. , 2014	4	100%
Small & Medium Enterprises				0	0%
All size				0	0%
Public Sector				0	0%
TOTAL	1	1	2	4	100%
%	25%	25%	50%		

Due to the low number of these quantitative studies, made exclusively on large companies, it's difficult to generalize results out of it. Nevertheless, results are encouraging, working on more complex model (between 5 and 30 indicators, 18 in average), introducing new metrics like Wieder et al., 2006 measuring manufacturing flexibility based on SCOR model (Calculation of SCOR version 3.1 metrics, Version 1.1, Institute of Manufacturing Technology, 2000). Even if Kallunki et al. [2008], are concluding out of their article that "firms should be able to translate the benefits of ERPS into better financial and non-financial performance", only 7 variables are positively correlated with performance improvement out of 30, financial indicators can't demonstrate any benefit (on 8 KPIs), and 16 variables are not significate indicators (construct validity of the PLS model). Last year, Galy E. and Saucedo M.J. [2014] found some evidence of ERP contribution to financial performance under several conditions, through an elaborate model: Net Sales improvements were positively correlated to technological competences empowerment, top management emotional support and success knowledge, NIB (Net Income Before extra items under preferred dividends) with top management success knowledge and sharing of information between department, improvements in EBIT when long range plans and relations with outside experts and ultimately,

better results on ROI & ROA when sharing of information between department and relations with outside experts. Tsai M-T. et al. [2011], brought on the spotlight that “the knowledge management mechanism has a positive effect on only financial performance, not on the internal process performance. On the other hand, “post-implementation maintenance of an ERP system has significant influence on the performance of a business”. Finally, Wieder et al. [2006] proposed the first multidimensional study through 8 financial variables and 19 non-financial ones, and gave the following conclusions: “the ERPS-users in our study failed to achieve higher supply chain performance, both in the short and long-term, and they failed to achieve higher overall firm performance”.

5 CONCLUSION

A Systematic Literature Review of 54 publications edited between 1999 and 2014 has provided the state of art regarding ERP contribution to firm performance produced by academic searchers. The detailed analysis has been based on two main dimensions, performance type (financial, non-financial, both) and firm size (Major companies, SMEs, All size, Public organizations).

As main results, ERP implementation on major companies have globally a positive impact, especially on a long period of time, even if it's most notable on non-financial dimension. On the other hand, due to the fact that ES are more recently deployed in SMEs, “the benefits of this type of integrated software for smaller organizations are still to be demonstrated” [Deltour et al., 2014]. Our study also demonstrates this lack of results on SMEs firms. Two main research avenues have been highlighted through this review: (1) The development of a comprehensive and practical performance measures for ERP systems, defining a theory on which academics and professional could rely on; (2) Complete performance assessment studies, with elaborate model, using multidimensional measures, giving new perspectives on ERP contribution to firm performance, especially on SMEs (“There is strong evidence that SMEs operate differently from large organizations”, Snider et al. [2009]). Even if non-studied in this review, the public sector organizations could also be an interesting field.

6 REFERENCES

References are presented in two subsections, first general articles quoted in this publication (6.1) and secondly the 54 articles reviewed in the SLR (6.2).

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