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Differences in ERP Value between Iberian Manufacturing and Services SMEs

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Abstract

Enterprise Resource Planning (ERP) system literature reports little research on the specificities of an industry analysis. Based on a theoretical model we assess ERP Value between Manufacturing and Services industries in Small and Medium Enterprises (SMEs) across the Iberian region (Portugal and Spain). The empirical test was conducted through structural equation modeling, using data from 261 firms. Results show that Firm size, Analytics and Collaboration contribute to ERP Value in those industries, with Analytics being more important for the Services industry.

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Keywords: Enterprise Resource Planning (ERP), ERP use, ERP Value, Manufacturing, Services, SMEs, Technology-Organizational-Environment, Resource-Based View.

1. Introduction

Enterprise Resource Planning (ERP) systems have been applied by many firms around the world as a key part of the organizational infrastructure. ERP encompasses a wide range of software products supporting day-to-day business operations and decision-making. ERP systems are expected to provide seamless integration of processes across functional areas with improved workflows, standardization of various business practices, improved order management, accurate accounting of inventory and better supply chain management [1, 2]. The ERPs are particularly important for manufacturing and services in Small and Medium Enterprises (SMEs) [3-5].

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Currently there is a process of structural change in Europe in which the share of manufacturing in the economy is declining while services are accounting for increasing shares of employment and value added [6]. The manufacturing and service industries are still the two main economic activities in the European Union [7, 8]. Several authors [9-11] state that SMEs are the backbone of Europe's economy, important for increasing productivity and gaining competitive advantage in the global economy, and also important drivers of innovation and transformation. Literature reveals that little attention has been given to research on ERP in SMEs, and even less on specific industries such as manufacturing and services [12]. To fill the gap, this paper addresses the following research question in the SME context: What are the drivers and differences in ERP Value between manufacturing and services industries?

To answer this question we tested a conceptual model based on Resource Based-View theory (RBV) previously published at CENTERIS 2016 [13] to explain ERP Value. To test the model we collected data of SMEs in the Iberian Peninsula region across manufacturing (158 firms) and service (103 firms) industries. Theoretical perspectives are presented next, then in Section 3 the research model and hypotheses are explained. The methodology is presented in Section 4, followed by results, discussion and conclusions.

2. Theoretical Perspectives

2.1. ERP adoption in Manufacturing and Service firms

ERP systems have traditionally been used by capital-intensive industries such as manufacturing, which were also more targeted by ERP vendors than the services industry [3]. However, more recently, there has been an increase of ERP systems implementations in the services industry [3].

It has been argued that the industry in which the firm operates influences the adoption of Information System (IS) innovations. Recent findings reveal that in the European context the most important feature to characterize Information Technology (IT) adoption is the industry and its specific characteristics rather than the country the firms belong to [5, 14, 15].

The services industry is quite unlike the manufacturing industry [16]. The growth of services in the European Union 27 countries raises questions about the adequacy of our understanding of innovation activities in service-dominated economies, especially as innovation is regarded as fundamental to the competitiveness of advanced economies [17]. Different industries have different operating characteristics and environments, and the factors related to ERP use and value may differ accordingly [11, 18]. As a result, it is also expected that there will be systematic differences in the actual use of ERP systems and related value creation between firms from manufacturing and services industries.

2.2. ERP Value and RBV theory

The RBV theory remains the dominant theoretical explanation of IT business value and many IS researchers have employed the resource perspective to expand and deepen the understanding of IT business value [19-21]. RBV sustains that a firm is able to create value by combining heterogeneous resources that are economically valuable, difficult to imitate, or imperfectly mobile across firms [22, 23]. In the IS literature RBV has been used to analyse how IT business value can be explained by the IT capability resource [24, 25]. Thus, an ERP system business value depends on the extent to which ERP systems are used in the key activities from the firm's value chain [11, 26]. The creation of value requires capabilities to effectively use ERP systems in the post implementation phase [27] and several studies have concluded that ERP systems can lead to sustained, competitive advantages [28, 29]. In line with RBV, the present study will take into account variables that can be perceived as valuable resources, to better understand how those resources can be used to improve firm performance and thereby to extract value from the ERP.

3. Research model and Hypotheses

ERP helps companies to develop appropriate functionalities to leverage firm performance, thereby contributing to value creation. It is hypothesized that ERP Value is explained by four determinants: ERP use, Collaboration, Analytics, and Firm Size. The conceptual model developed to assess the value of ERP is presented in Figure 1.

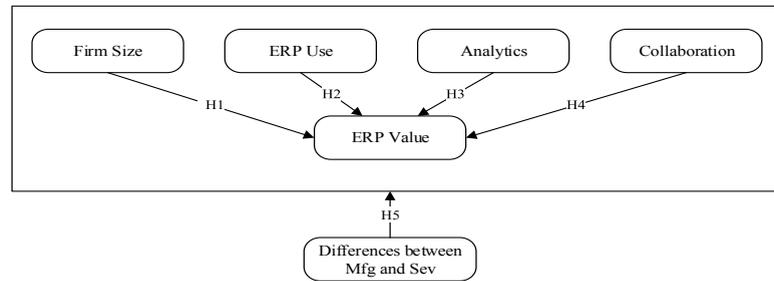


Fig. 1 The Research Model

The literature reveals that larger firms often possess more resources that can facilitate innovation implementation [30], and smaller firms, although more versatile, are characterized by severe resource constraints and do not readily adopt new technologies [31]. Therefore, we postulate that the available resources and the financial capital which larger firms may possess will have a positive impact on the adoption and use of ERP, and as a result, on value creation.

H1. Firm size is positively associated with ERP Value.

IT business value depends on the extent to which IT is used in the key activities in the firm's value chain [22, 29]. The greater the use, the more likely the firm will develop unique capabilities from its core IT infrastructure [26]. System use is essential for ERP to generate any impact on firm performance, and a strong link can therefore be established between system use and system impact [25, 32, 33].

H2. Firms with greater ERP use are more likely to generate higher ERP Value

Business analytics systems can potentially contribute to firm performance and create competitive advantage [34, 35]. According to Bendoly [36], the adoption of ERP systems has been accompanied by an explosion of readily available transactional data. Firms that have embedded analytics capabilities into the ERP database can easily and quickly use data for managerial decision-making and consequently get advantage to attain sustainable business performance [37, 38].

H3. Firms with greater levels of analytical information from ERP are positively associated with higher ERP Value.

The literature firmly supports that the organizational culture promoting the free-flow of information and sharing of knowledge amongst employees and across department lines is important for ERP implementation's success, in the same way that ERP implementation changes the organizational culture promoting the free-flow of information and sharing of knowledge amongst employees and across department lines [39, 40]. ERP systems help users to collaborate, increasing efficiency and effectiveness [41, 42]. Thus, it is plausible that firms with greater collaboration are positively associated with higher ERP Value.

H4. Firms' greater collaboration in ERP systems is positively associated with higher ERP Value.

Sohal et al. [43], in their work, reported that manufacturing and service firms achieved few benefits in general, from their IT investments. Major benefits achieved in both industries have been limited to improvement in productivity and cost reductions. The structure of services firms is inherently different from manufacturing firms, and given the distinct nature of the offerings, different drivers for ERP Value across these two different types of firms is very plausible.

H5. The antecedents of ERP use and value will differ between Manufacturing and Services Firms.

4. Method

The constructs were operationalized based on the literature review (Appendix) and using an online survey. Whereas the ERP Use construct was measured through items calling for responses in percentages, all other constructs were measured using a five-point Likert scale, with the anchors being "low" and "high". The questionnaire was reviewed for content validity by a panel of five established IS researchers and two language experts. The initial questionnaires were pilot tested on thirty firms, and some items were revised for clarity. To ensure the generalization of the survey results, the sampling was stratified by country (Portugal and Spain), by firm size, by industry (manufacturing and services). The control variables used were Country and Industry type. With the assistance of IDC, 261 surveys (158 Manufacturing and 103 Services) were collected (Table 1).

Table 1 Sample Characteristics

		Full Sample (n=261)	Manufacturing (n=158)	Services (n=103)
Respondent Type	CEO	19.6%	24.1%	12.6%
	Manufacturing Manager	18.0%	29.7%	0%
	Finance Manager	12.4%	15.2%	7.8%
	IT/IS Manager	23.8%	17.1%	34.9%
	Sales Manager	26.2%	13.9%	44.7%
Annual Turnover	€10 to 50 million	46.4%	50.6%	39.8%
	€2 to €10 million	53.6%	49.4%	87.4%

Note: The annual turnover is presented in accordance of the European Commission SME definition [44].

The response rate was 39.8%. Respondents were individuals (e.g., Chief Executive Officer (CEO), Chief Financial Officer (CFO), and business managers) who were qualified to speak about the company's ERP system, which suggests a good quality of the data. The sample covered various types of businesses and represented small (€2 to €10 million) and medium companies (€10 to €50 million).

5. Results

The Kolmogorov-Smirnov test was performed, confirming that none of the items measured are distributed normally ($p < 0.001$). This allows for safe use of Partial Least Square (PLS) for the analysis of our model, and does not require a normal distribution [45]. The results of the measurement model (construct reliability, indicator reliability, convergent validity, and discriminant validity) for the full sample are reported in Tables 2 and 3. We also computed these tables for each industry (available from author on request) and the results are similar. The construct reliability was tested using the composite reliability coefficient. PLS prioritizes indicators according to their individual reliability. As shown in Table 2, all the constructs have a composite reliability greater than 0.7, which suggests that the constructs are reliable [45]. The indicator reliability was evaluated based on the criteria that the loadings should be greater than 0.70, and that every loading less than 0.4 should be eliminated [46]. As shown in Table 3, the loadings (in bold) are greater than 0.7. Hence, only two items in the table were eliminated (EV1 and EV3). All the items are statistically significant at 0.001. Overall, the instrument presents good indicator reliability.

Table 2 Correlation Matrix, Composite Reliability (CR), and square root of AVE

Constructs	CR	FS	EU	AN	CO	EV
Firm Size (FS)	0.91	0.92				
ERP use (EU)	0.83	0.55	0.79			
Analytics (AN)	0.86	0.22	0.31	0.82		
Collaboration (CO)	0.91	0.32	0.24	0.38	0.88	
ERP Value (EV)	0.92	0.49	0.42	0.52	0.63	0.89

Notes: CR is Composite Reliability. Diagonal elements are square root of Average Variance Extracted

Average Variance Extracted (AVE) was used as the criterion to test convergent validity. The AVE should be higher than 0.5 in order for the latent variable to explain more than half of the variance of its indicators [46]. As shown in Table 2, all constructs have an AVE higher than 0.5, fulfilling this criteria.

Discriminant validity of the constructs was assessed using two criteria [45]. The first criteria postulates that the square root of AVE should be greater than the correlations between the construct. The second criteria requires that the loading of each indicator should be greater than all cross-loadings [46]. As seen in Table 2, the square roots of AVE (diagonal elements) are higher than the correlation between each pair of constructs (off-diagonal elements). Table 3 shows the loadings greater than the cross-loadings. Thus, both measures are satisfied.

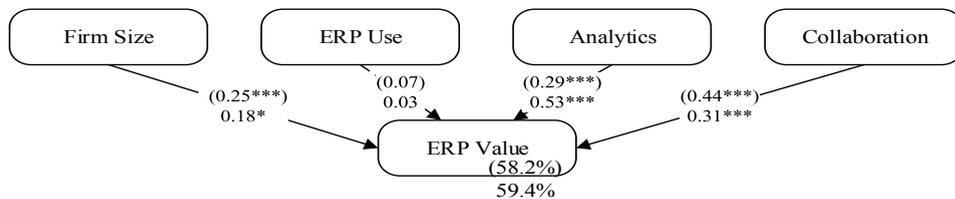
Table 3 Loadings and cross-loadings for the measurement model

Constructs	FS	EU	AN	CO	EV
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Firm Size (FS)	FS1	0.91	0.47	0.25	0.33	0.48
	FS2	0.92	0.54	0.15	0.25	0.42
ERP use (EU)	EU1	0.64	0.70	0.08	0.14	0.34
	EU2	0.32	0.82	0.30	0.17	0.31
	EU3	0.37	0.85	0.35	0.25	0.34
Analytics (AN)	AN1	0.36	0.33	0.78	0.39	0.44
	AN2	-0.02	0.22	0.84	0.17	0.26
	AN3	0.12	0.21	0.83	0.31	0.50
Collaboration (CO)	CO1	0.32	0.31	0.37	0.94	0.69
	CO2	0.32	0.22	0.32	0.89	0.55
	CO3	0.14	-0.01	0.30	0.80	0.33
ERP Value (EV)	EV2	0.51	0.46	0.47	0.63	0.94
	EV4	0.57	0.37	0.36	0.59	0.91
	EV5	0.18	0.27	0.60	0.44	0.80

The assessment of construct reliability, indicator reliability, convergent validity, and discriminant validity of the constructs is satisfactory, indicating that the constructs can be used to test the conceptual model.

The analysis of hypotheses was based on the examination of the standardized paths. The significance of the path coefficients was assessed by bootstrapping procedure with 500 times resampling [45]. Figure 2 shows the standardized path coefficients and statistical significance, as well as the R² values for dependent constructs, for both manufacturing (in parentheses) and services (without parentheses) industries.



Notes: Control variables are Country and Industry; Significant at: *p<0.10, **p<0.05, ***p<0.01.

Fig. 2 Conceptual model testing (Manufacturing subsample N=158; Services subsample N=103)

The results for the Manufacturing industry, in parentheses, are summarized as follows. An examination of R² as a descriptive measure shows that the research model explains 58.2% of variation in ERP Value. The model shows that there is not a statistically significant link from ERP use to ERP Value (H2) ($\hat{\beta} = 0.07$; $p > 0.10$), and thus H2 is not confirmed. Analytics (H3) ($\hat{\beta} = 0.29$; $p < 0.01$), Collaboration (H4) ($\hat{\beta} = 0.44$; $p < 0.01$), and Firm Size (H1) ($\hat{\beta} = 0.25$; $p < 0.01$) have a positive and statistically significant path to ERP Value. Therefore H3, H4, and H1 are confirmed.

The results for the Services industry, without parentheses, are summarized as follows. An examination of R² as a descriptive measure shows that the research model explains 59.4% of ERP Value. The model shows that there is not a statistically significant link from ERP use to ERP Value (H2) ($\hat{\beta} = 0.03$; $p > 0.10$), and thus H2 is not confirmed. Analytics (H3) ($\hat{\beta} = 0.53$; $p < 0.01$), Collaboration (H4) ($\hat{\beta} = 0.31$; $p < 0.01$), and Firm Size (H1) ($\hat{\beta} = 0.18$; $p < 0.10$) have positive and statistically significant paths to ERP Value. Therefore, H3, H4, and H1 are confirmed.

In a deeper analysis, the differences between the statistically significant path coefficients across Manufacturing and Services subsamples were tested, based on Keil et al.'s [47]. Table 4 shows that regarding ERP Value, Analytics is a more important factor among Services firms than among Manufacturing firms.

Table 4 Results of Manufacturing and Services subsamples and t-tests for the difference in paths between subsamples

	Manufacturing Path Coeff.	Service Path Coeff.	Comparison (Mfg vs Sev) Two-tailed test	p-value
ERP Value				
ERP use → ERP Value	ns	ns	-	-
Analytics → ERP Value	0.29***	0.53***	-2.25**	0.02
Collaboration → ERP Value	0.44***	0.31***	1.31	0.19

Firm Size → ERP Value	0.25***	0.18*	0.60	0.55
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Note: *p<0.10, **p<0.05, ***p<0.01; ns – non-statistically significant results.

Overall, the above results provide support for the cross-industry differences in the determinants shaping ERP Value (Analytics is more important for the Services industry), thereby confirming H5.

6. Discussion

Surprisingly, the findings suggest that *ERP Use (H2)* is not important to understand ERP Value in either industry. Manufacturing and Services firms have been the major targets of ERP vendors, and it is plausible to assume that through ERP utilization, both sectors have gained a specific resource that guides both internal and external collaboration and provides a data repository to perform business analyses. Therefore, with further utilization, the perception of ERP success usage drops, while increasing the necessity of collaboration, to serve new possibilities for using information to improve business processes, and to use operational data to generate reports that support decision-making and resource planning. This finding enhances earlier studies [5, 25, 32] to suggest that system utilization should not be analysed in isolation. More precisely, our study shows that when system use is positioned together with other organizational system factors, it does not influence the IT value.

In line with this, *Analytics (H3)* contributes to value creation of ERP in both industries. ERP systems priority is improving transaction handling through the standardization of business processes and integration of operations and data, allowing for consistent and unified internal data [48]. We can assume that the Manufacturing and Services industries are using the analytical capability features of ERP to create new resources and capabilities in response to changing market conditions, thereby leading to a competitive advantage. In a further analysis (Table 4), our findings indicate that the analytical capabilities of the ERP are more important for Services than Manufacturing firms. This does not mean that the Manufacturing industry disregards the potential contribution of analytics to improve business decisions, but Services industry is more information-intensive in nature, requiring more analytical processing and distribution of information than Manufacturing [37, 49].

Collaboration (H4) contributes positively to ERP Value in both industries. A firm's competitive advantage resides in its ability to leverage collaboration along its supply chain and transform existing business processes [50]. Since ERP is a tool that helps companies to cut costs and improve efficiency by integrating business processes and sharing common resources across an organization [51], it becomes a fundamental resource to optimize processes at every network node of the Manufacturing and Services industries' value chain.

Firm size (H1) is an important determinant for the value creation of ERP in both industries. ERP implementation is a complex, expensive, and time consuming project [40]. Considering that larger companies have more resources and greater capacity for risking such an investment, they are more likely to adopt and use ERP, understand its capabilities, and can apply the benefits to the firm's business, thereby extracting value in an effective way.

Managerial implications

The principal role of Manufacturing is to turn physical raw materials into tangible products. Services, on the other hand, generally implies an act and may also provide a "product", but one that is often intangible and cannot be described in the same dimensional terms as manufactured goods [3]. Thus, the major differences rely in the relative weight of information and customer service (for the Services industry) and goods (for the Manufacturing industry) in the value creation of operational processes. This makes it especially important for vendors and managers to understand that each industry has different needs that will require different implementation methodologies and systems functionalities based on standard best-practices.

Academic implications

This study has important implications for theory. Firstly, the present research incorporates RBV theory to understand ERP Value. The research model has been verified for reliability, validity, and discriminant tests, and can be used in related studies in the future. Secondly, to the best of our knowledge no earlier studies have focused on the difference in specific industries to analyse ERP Value. Thus, this study can serve as a guide for researchers considering which factors are most important for using ERP and extracting value from it, according to the specificities of the industry itself. Lastly, as SMEs account for a significant portion of the European economy, this study also contributes to a better understanding of ERP post-adoption stages in SMEs, regarding two important industries.

Limitations and future work

As this study does not take into account the number of years using ERP, further research could be extended to the maturity stages of ERP amongst these two industries. Moreover, we cannot extend the results to industries from other countries (apart from Portugal and Spain) that might have different operating characteristics and environments, and the factors to ERP Value may differ. An interesting study would be to compare industries from other countries.

7. Conclusions

In this study we assess the determinants of Enterprise Resource Planning (ERP) value. Grounded on the Resource Based View (RBV) theory, we tested a research model for assessing ERP Value at the firm level. It was tested using a sample of 261 Iberian Small and Medium Enterprises (SMEs) from the Manufacturing and Services industries. The study demonstrates that Analytics, Collaboration, and Firm size are important determinants for ERP Value, although Analytics is more important for the Services industry. This study also shows that when ERP Use is positioned together with other organizational system factors such as Firm Size, Collaboration and Analytics capabilities, ERP Use loses its influence in explaining the ERP Value.

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Appendix: Measure Items

Constructs	Items	Literature support
Using a five-point scale, where 1 means “low” and 5 “high”, respondents were asked to rate their perception		
Firm Size	S1 – The number of company employees (#) S2 – Annual Business Volume (€)	[52, 53]
ERP Use	According to users, please rate the degree of how easy it is for them . . . ERP1 . . . many employees use the system daily? (#) ERP2 . . . much time per day do employees work with the system? (%) ERP3 . . . many reports are generated per day? (%)	[11, 25, 54]

Analytics	Please rate the degree of ERP impact on . . . AN1 . . . comprehensive reporting (KPIs, Dashboards, etc.) AN2 . . . real-time access to information AN3 . . . data visibility across departments	[11, 55, 56]
Collaboration	According to ERP system, please rate the degree of . . . CO1 . . . collaborate with colleagues CO2 . . . collaborate with the system CO3 . . . communicate with suppliers, partners, and customers	[11, 41, 55]
ERP Value	Please rate the degree of ERP impact on... ERPV1 . . . user satisfaction ERPV2 . . . individual productivity ERPV3 . . . sales growth ERPV4 . . . customer satisfaction ERPV5 . . . management control	[11, 25, 33, 54]