

ERP use and value: Portuguese and Spanish SMEs

Pedro Ruivo (Instituto Superior de Estatística e Gestão de Informação, Universidade Nova de Lisboa, Lisbon, Portugal)

Tiago Oliveira (Instituto Superior de Estatística e Gestão de Informação, Universidade Nova de Lisboa, Lisbon, Portugal)

Miguel Neto (Instituto Superior de Estatística e Gestão de Informação, Universidade Nova de Lisboa, Lisbon, Portugal)

This is the author peer-reviewed version of the article published by EMERALD as:

Ruivo, P., Oliveira, T., & Neto, M. (2012). ERP use and value: Portuguese and Spanish SMEs. *Industrial Management & Data Systems*, 112(7), 1008–1025.

<https://doi.org/10.1108/02635571211254998>



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Pedro Ruivo
ISEGI, Universidade Nova de Lisboa
Lisbon, Portugal
pruivo@isegi.unl.pt

Tiago Oliveira
ISEGI, Universidade Nova de Lisboa
Lisbon, Portugal
toliveira@isegi.unl.pt

Miguel Neto
ISEGI, Universidade Nova de Lisboa
Lisbon, Portugal
mneto@isegi.unl.pt

Abstract

Purpose – Consistent with the *diffusion of innovation* (DOI) model and *resource-based view* (RBV) theory, this paper develops a research model for measuring *enterprise resource planning* (ERP) post-adoption and its consequence on *small and medium enterprise* (SME) performance.

Design/methodology/approach – The model links six determinants based on DOI to explain ‘ERP use’ and three determinants based on RBV to explain the ‘ERP value’, on which nine hypotheses are postulated. Testing was conducted through structural equation modelling, utilizing data from 558 web-surveyed firms in Portugal and Spain.

Findings – Full sample analysis finds that competitive pressure, training, best-practices, compatibility, and efficiency are important antecedents of ‘ERP use’. Together with usage, collaboration and analytics capabilities contribute to ‘ERP value’. Cross-country analysis reveals that complexity is an important inhibitor for ‘ERP use’ in Portuguese firms whereas it is a facilitator for Spanish firms. In addition, while for Portuguese firms, compatibility and efficiency are significant, they are not for Spanish. For ‘ERP value’, while use and collaboration are more important for Portuguese firms, analytics is more important for Spanish.

Research limitations/implications – This study provides insight into how SMEs use and value ERP, however, we cannot speak empirically on the issue of whether value is sustained, or on maturity stages, or on the impact of different industries.

Originality/value – This is the first empirical research study on Iberian SMEs, thus adding a cross-country dimension to the innovation diffusion literature. Unlike the typical focus on ERP adoption found in the literature, this study focuses on post-adoption stages, linking actual usage with value.

Keywords – ERP, SMEs, diffusion of innovation, resource-based view, post-adoption, use, value.

Paper type – Research paper.

1. Introduction

As suggested in the literature, innovation is more and more identified as the transformative force that creates and shapes new economies in today's digital world. Firms often adopt *information systems* (IS) to upgrade or improve their business performance and be more competitive (Ho and Tai, 2004). Davenport (1998) qualified *enterprise resource planning* (ERP) systems as the most important development in enterprises' use of *information technology* (IT). ERP's main purpose is to integrate functions of financial management, supply chain management, and customer relationship management to the greatest extent possible. Such systems manage both information and resources by supporting execution of operational transactions and advanced planning, alongside real-time data access (Klaus *et al.*, 2000).

As with many other technological innovations, ERP systems were initially implemented mostly in large organizations, and this has probably been the main reason for research to focus on large enterprises. Although *small and medium enterprises* (SMEs) have been adopting ERP systems for many years, the literature reveals that little attention has been given to research on ERP in SMEs, and less on cross-national studies. Moreover, according to the European Commission (2011), 99% of all European firms have fewer than 250 employees, and both Portugal and Spain adhere to this profile, and with the same percentage. Because SMEs are the backbone of the economy, important for increasing productivity and gaining competitive advantage, as well as being important drivers of innovation and transformation, it is valuable to study ERP at the SME level across countries (Hitt *et al.*, 2002, Raymond and Uwizeyemungu, 2007, Chuang *et al.*, 2009, Maguire *et al.*, 2010).

As the impact of IT systems on a firm's performance is mostly long term and indirect, measures of the value to business are linked primarily to system usage (Devaraj and Kohli, 2003, Zhu and Kraemer, 2005). The current investigation explores an alternative way to understand and measure IT value by studying ERP in its post-adoption phases; use and value. We develop and test a model based on the *Diffusion of Innovation* (DOI) model and *resource-based view* (RBV) theory.

The theoretical perspectives and research model proposed to explain use and value are outlined in next two sections. The appropriateness of the model is then tested using a sample of 588 firms. Tests for differences based on Portugal and Spain are also conducted. Finally, we discuss our results and offer implications and conclusions.

2. Theoretical perspectives

2.1. ERP use and diffusion of innovation

Whereas ERP implementation refers to the stage of system planning, configuration, testing, and "going-live", ERP use means ERP utilization. It refers to the experience of managing the operation of the system software throughout the system's post-implementation stages (Nah *et al.*, 2004, Liang *et al.*, 2007). In line with literature we consider ERP to be a type of innovation that is implanted in a firm's core business processes in order to leverage performance (Rajagopal, 2002, Zhu and Kraemer, 2005). Not only does it extend basic business and streamline integration with suppliers and customers, it also directs system usage to the firm's performance. Rogers' (1995) DOI model seeks to explain and predict if and how an innovation is used within a social system, with regard to performance at the firm level. Research conducted by Bradford and Florin (2003), Waarts *et al.* (2002) and Light and Papazafeiropoulou (2004) verifies DOI determinants regarding ERP use. Considering their findings, we believe that DOI has the potential to provide a favourable framework for explaining ERP use.

2.2. ERP value and resource-based view

While ERP use refers to the production stage of system usage among firms actually using ERP in their daily business activities, ERP value refers to firms' ability to utilize ERP to create a competitive advantage. It refers to the ERP impact on a firm's performance, throughout the system life in the post-adoption stages (Rhodes *et al.*, 2009). Since ERP's value relies on how firms strategically exploit the system, firm's performance in a competitive environment is a subject that draws much attention and some authors attempt to build explanatory

theories. One of the most recognized is the RBV theory, which states that firm-specific resources determine the firm's performance. It is linked to the competitive advantage approach to strategic management and can explain sustained advantages (Hedman and Kalling, 2003). In the IS literature, the RBV has been used to analyse IT capabilities as a resource and to explain IT business value. That is, IT business value depends on the extent to which IT is used in the key activities of the firm. The greater the use, the more likely the firm is to develop unique capabilities from its IT business applications (Bharadwaj, 2000, Zhu and Kraemer, 2005, Antero and Riis, 2011). Hedman and Kalling (2003) and Fosser *et al.* (2008) used RBV to extend Mata *et al.*'s (1995) framework for organizational and business resources and concluded that ERP systems are IT resources that can lead to sustained, competitive advantages. With this in mind, our theoretical model for ERP value will include variables that input value to ERP and positively impact the predisposition to extract value from the system.

3. Research model and hypotheses

The post-adoption model presented in Figure 1 outlines our proposal that the DOI model explains 'ERP use' and RBV theory explains 'ERP value'. The left-hand side shows the extent of 'ERP use', influenced by six factors embedded in the DOI context: compatibility, complexity, efficiency, best-practices, training and competitive pressure. On the right-hand we postulate that 'ERP value' is explained by: 'ERP use', collaboration, and analytics.

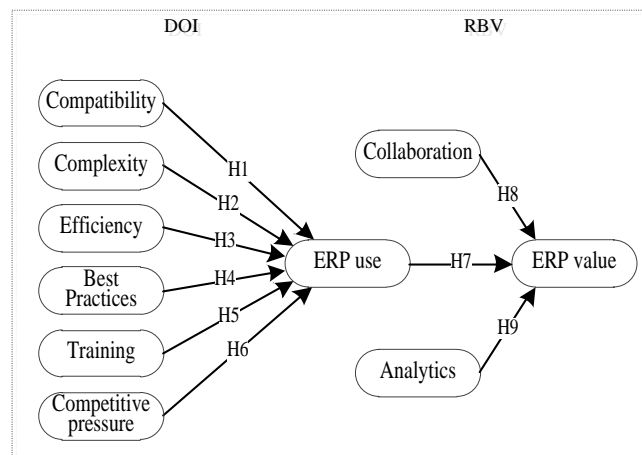


Figure 1. Research model

3.1. Hypotheses to explain use

Based on DOI literature, compatibility and complexity have shown consistent associations with IS adoption. O'Leary (2000) and Bradford and Florin (2003) report that best-practices, training, and competitive pressure are also important dimensions for ERP usage. We contribute to this research by including the level of transactional efficiency as an important dimension that will influence ERP usage, and therefore postulate six hypotheses.

Compatibility

Compatibility is measured by the degree to which the ERP system matches IT features, such as compatibility with hardware and other software. Bradford and Florin (2003) and Elbertsen *et al.* (2006) concluded that the degree of compatibility of ERP systems with existing software and hardware will have a positive relationship with implementation success (system adoption and use). We thus formulate the first hypothesis:

Hypothesis 1. Firms having ERP systems with greater compatibility are more likely to achieve more ERP use.

Complexity

Cooper and Zmud's (1990) research indicates that system usage enhances job performance. Studies conducted by Kositanurit *et al.* (2006) and Chang *et al.* (2011) conclude that ERP complexity is a major factor affecting

user performance. Bradford and Florin (2003) concluded that ERP complexity is a critical factor for successful implementation. When users find it difficult to obtain the desired result from the ERP, frustration and unwillingness to use the system generally result. When users are comfortable using ERP, it scales up the users' knowledge of the system and, so too, their skills in manipulating the system in effective ways. Moreover, it prepares users to comprehend the system trends sufficiently and comprehensively (Yu, 2005). Based upon this, we state our second hypothesis:

Hypothesis 2. Firms having ERP systems that are perceived to be complex are less likely to use ERP.

Efficiency

Bendoly and Kaefer (2004) assessed transactional efficiency on data posting and found that its communication over the ERP improves the firm's overall performance. Rajagopal (2002) found that transactional efficiency has a direct influence on ERP use. Business process benefits of ERP investment include transactional efficiency, where reliability effectiveness on the application improves user confidence. Along the same lines, Gattiker and Goodhue (2005) found that coordination improvements and efficiency are significant benefits to ERP use. Taking this background into account, we construct our third hypothesis:

Hypothesis 3. Firms having ERP systems with greater transactional efficiency are more likely to use ERP.

Best Practices

From the perspective of business process reengineering, there are two main options in implementing ERP systems: modify (customization) the ERP package to suit the firm's requirements (with high costs), or the implementation of an ERP package with minimum deviation from the standard settings (with lower costs) (Davenport, 1998). According to Light and Papazafeiropoulou (2004), Velcu (2007) and Chou and Chang (2008) the reason for adopting 'best practice' is the belief that ERP design does things in the right way, that is, using the standard business process embedded in the software package without or with low minimum deviation from the standard. In line with Wenrich and Ahmad (2009) and Maguire *et al.* (2010), firms that implement industry best-practices dramatically reduce risk and time-consuming project tasks such as configuration, documentation, testing, and training. Thus, we postulate that firms that opt to implement ERP based on standard best-practices will use the system more. Based on these considerations, we formulate the fourth hypothesis:

Hypothesis 4. Firms with a greater degree of business process fit to standard ERP 'best-practices' are more likely to use ERP.

Training

Several researchers, including O'Leary (2000), Bradford and Florin (2003), and Maguire *et al.* (2010) state that one of the main determinants for successfully adopting, using, and benefiting from ERP systems is the training of the users. The state of preparedness of users to meet situations and carry out a planned sequence of actions without upstream errors has an instantly positive impact on business. These researchers state that the level of the training programme that employees undergo with respect to ERP systems should focus on content, format and applicability, providing knowledge and skills to employees on how to use the system that improves familiarity and boost its use. We therefore postulate that firms with a higher level of training programme raise employees' readiness to use ERP. In line with research, we construct the fifth hypothesis:

Hypothesis 5. The level of firms training programme will have a positive relationship with ERP use.

Competitive pressure

Competitive pressure has long been recognized in the innovation diffusion literature as an important driver of technology diffusion (Bradford and Florin, 2003, Zhu and Kraemer, 2005, Oliveira and Martins, 2010b). These studies have shown that innovation diffusion is accelerated by the competitive pressure in the environment. Thus, we postulate that competitive pressure plays an important role in pushing firms toward using ERP systems. In line with research, we construct the sixth hypothesis:

Hypothesis 6. Firms facing higher competitive pressure are more likely to use ERP.

3.2. Hypotheses to explain value

From the RBV perspective, some (albeit few) researchers have shown that amount of use is associated with firm performance (Mabert *et al.*, 2001). We contribute to this research by considering collaboration and analytics to be additional important dimensions that will influence ERP value, and therefore postulate three hypotheses.

ERP use

The link between ERP use and ERP value is a measure of the breadth and depth of how users work with the system and of decision-making based on analytical indicators. To explain the connection between usage and value, we support our proposition on RBV; the greater the extent of ERP use, the greater the likelihood that firms will create capabilities that are rare, inimitable, valuable, and sustainable, thereby contributing to value creation. A study conducted by Shahin and Ainin (2011) found that user fit on ERP is critical in explaining the ERP usage, and a successful adaptation with firms' processes and data flow from other IS makes ERP worthwhile. With ERP systems (and their integration capability with other systems) firms can form a specific resource that guides both internal and external collaboration and provides the repository to perform business analyses. As a result, it is only when firms are actually using ERP systems to conduct business that ERP can have an impact on firm performance. Obviously, without system usage it is impossible for ERP to generate any impact on firm performance (Devaraj and Kohli, 2003, Zhu and Kraemer, 2005). These researchers demonstrate that there is a strong link between system use and system impact. In line with literature, we formulate the seventh hypothesis as:

Hypothesis 7. Firms with greater ERP use are more likely to generate higher ERP value.

Collaboration

Calisir and Calisir (2004), Gattiker and Goodhue (2005), and Ruivo and Neto (2011) support the conclusion that ERP systems help users to collaborate; up, down, and across their department, company, and industry ecosystem, increasing their productivity and the health of their firms and business partners. ERP is a kind of gateway to unique functions. That is, ERP is the *sine qua non* factor for others (both humans and applications) to collaborate with ERP – from meeting service-level agreements to promoting enterprise performance. ERP systems provide users with a structured communication channel with the right information at the right time, resulting in increased efficiency and effectiveness. We believe that partnering with ERP and cross-group collaboration amplifies the ERP value. Therefore, and in line with RVB theory, we postulate the eighth hypothesis:

Hypothesis 8. Firms' greater collaboration ERP systems are positively associated with higher ERP value.

Analytics

Davenport and Harris (2007) stated that “analytics is not new” but that not many firms give it priority. Firms generally use business analytics to leverage the investment they have made in ERP systems. In seeking to gain competitiveness, firms use integrated data and set analytics as a strategic initiative. The common data model and visibility across functional departments allows firms' metrics to be unified and consistent. Although ERP systems are essentially transaction-focused on internal data, those firms that use ERP-embedded analytics capabilities can easily and quickly use data for managerial decision making and realize an advantage in their pursuit of sustainable performance (Chiang, 2009, Ruivo and Neto, 2011). In line with RVB theory and literature, we believe that analytics provides users with unique business insight information, and therefore we construct the ninth hypothesis:

Hypothesis 9. Firms with greater levels of analytical information extracted from ERP are positively associated with higher ERP value.

ERP value measurement

Studies conducted by Park *et al.* (2007) and Chang *et al.* (2011) concluded that ERP value output can be measured by three dimensions: individual productivity, customer satisfaction, and management control. Furthermore, both Zhang *et al.* (2005) and Bradford and Florin (2003) established user satisfaction as an

important dimension of ERP value. In our study, we assess the positive impact of an ERP system on firm performance by user satisfaction, individual productivity, customer satisfaction, and management control.

3.3. Hypothesis to explain the differences between countries

According to the European Commission (2011), although Spain is five times larger than Portugal, it had a negative growth rate of *Gross-Value Added* (GVA) produced by private businesses in 2010, while Portugal had a positive growth rate. Rogers (1995) and Zhu and Kraemer (2005) found that diffusion occurs differently across countries due to different environments. Looking specifically at the use of ERP, as country home market dimension and consumer product demand define industry type, firm's strategies, and country overall GVA, it therefore shapes ERP value across countries. In this line, we wish to understand the differences of ERP use and value across countries and therefore we construct the tenth hypothesis, as a result:

Hypothesis 10. The antecedents of ERP use and value will differ for Portuguese and Spanish SMEs.

4. Research methodology and data

A survey methodology is proposed for data collection to validate the research model and test its nine hypotheses. Each survey item-question was reviewed for content validity by ERP experts; three academics and two consultants. The initial questionnaires were pilot tested on 10 firms, and some items were revised for clarity. The finalized questionnaire was designed to be answered in 15 minutes (Malhotra and Birks, 2007). With the assistance of International Data Corporation (IDC) we conducted a web-survey during September and October 2011. To ensure the generalization of the survey results, the sampling was stratified by country (Portugal and Spain), by firm size (fewer than 250 employees), and by industry (finance, distribution, manufacturing, and professional services). Questionnaires were translated into the two languages and sent only to firms that use ERP in conducting their business. In total, 1400 (1000 Spanish and 400 Portuguese) firms received the email survey, and 588 valid responses were returned (424 Spanish and 134 Portuguese). Table I shows the sample characteristics; approximately 70% of Portuguese firms responded that they had been using ERP for less than five years, while Spanish firms expressed 40%. The wide range of the respondent and industry types, suggests the good quality of the data source.

Characteristics	Full sample (N=558)		Portugal (N=134)		Spain (N=424)	
	Frequency (%)	Cumulative (%)	Frequency (%)	Cumulative (%)	Frequency (%)	Cumulative (%)
Number of years using ERP						
<2	28.0	28.0	36.6	36.6	19.7	19.7
2-5	26.8	54.7	33.3	69.5	20.3	39.9
5-10	31.4	86.1	27.5	97.0	35.3	75.2
>10	13.9	100.0	3.0	100.0	24.8	100.0
Industry type						
Distribution	29.6	29.6	28.4	28.4	30.0	30.0
Manufacturing	30.8	60.4	23.9	52.2	33.0	63.0
Finance	19.2	79.6	24.6	76.9	17.5	80.4
Services	20.4	100.0	23.1	100.0	19.6	100.0
Respondent type						
CEO, owner	18.5	18.5	20.9	20.9	17.7	17.7
IT/IS manager	27.4	45.9	27.6	48.5	27.4	45.0
Finance manager	19.9	65.8	20.1	68.7	19.8	64.9
Sales manager	22.9	88.7	23.1	91.8	22.9	87.7
Manufacturing manager	11.3	100.0	8.2	100.0	12.3	100.0

Table I. Characteristics of the samples

The constructs were operationalized on the basis of a literature review (shown in Appendix A). Constructs were measured using a survey instrument and multiple indicator items to strengthen validity. Whereas the 'ERP use' construct was measured by items calling for responses in percentages, all other constructs were measured by item responses on a five-point Likert scale ranging from 1=low to 5=high. The control variables used were country, size, and industry type.

5. Data analysis and results

A structural equation model was conducted to empirically assess the constructs theorized above. Because our purpose is to exam the validity of the constructs and does not require normal distribution for the variables, we used the *partial least squares* (PLS) as implemented in the software SmartPLS. We performed the Kolmogorov-Smirnov test and confirmed that none of the items measured are distributed normally ($p < 0.001$). In accordance with Chin (1998), factor loadings should be at least 0.6 and preferably greater than 0.7. For this reason CB3, CX1, TN1, CP2, and ERPU1 question-items of Appendix A were excluded from our research model following the PLS model estimation due to low loadings. We retain the items presented in Table II, except for BP2 (0.691), all other items have loadings above 0.7 and are significant at ($p < 0.001$). Furthermore, Table II shows that *composite reliability* (CR) and *average variance extracted* (AVE) for each construct are above the cut-off of 0.7 and 0.5, respectively (Hair *et al.*, 1998).

Item	Full sample (N=558)		Portugal (N=134)		Spain (N=424)	
	Loading	t-Stat*	Loading	t-Stat*	Loading	t-Stat*
CB1	0.978	480.195	0.925	7.360	0.953	178.696
CB2	0.981	637.229	0.991	12.141	0.963	231.001
CX2	0.771	3.734	0.936	97.797	0.813	10.621
CX3	0.965	7.020	0.919	93.032	0.923	24.525
EF1	0.790	29.259	0.764	32.003	0.823	36.359
EF2	0.796	26.170	0.768	26.920	0.810	34.927
EF3	0.842	30.017	0.880	61.194	0.806	26.461
BP1	0.820	44.817	0.796	33.578	0.820	39.199
BP2	0.716	19.890	0.691	18.552	0.719	18.002
BP3	0.825	38.751	0.880	60.196	0.811	33.816
TN2	0.939	173.910	0.954	269.978	0.931	148.220
TN3	0.936	156.885	0.961	345.770	0.936	148.252
CP1	0.957	168.484	0.983	161.226	0.948	193.680
CP3	0.859	48.499	0.784	23.648	0.878	61.211
ERPU2	0.894	117.847	0.894	137.936	0.900	114.363
ERPU3	0.871	84.732	0.875	84.041	0.851	62.882
CO1	0.893	151.719	0.898	188.766	0.892	150.663
CO2	0.828	72.089	0.887	156.042	0.803	59.303
CO3	0.808	44.080	0.818	53.113	0.805	44.901
AN1	0.829	72.541	0.875	111.851	0.816	62.040
AN2	0.883	91.012	0.903	103.026	0.878	89.616
AN3	0.777	49.521	0.874	84.742	0.746	41.004
ERP V1	0.725	46.535	0.747	52.967	0.721	45.912
ERP V2	0.900	156.543	0.927	225.381	0.893	133.216
ERP V3	0.846	92.060	0.862	87.722	0.841	93.742
ERP V4	0.745	48.323	0.703	34.468	0.754	48.440
Construct	CR	AVE	CR	AVE	CR	AVE
Compatibility (CB)	0.980	0.960	0.958	0.919	0.957	0.917
Complexity (CX)	0.864	0.763	0.925	0.860	0.861	0.757
Efficiency (EF)	0.851	0.656	0.847	0.649	0.854	0.661
Best Practices (BP)	0.831	0.622	0.834	0.628	0.827	0.616
Training (TN)	0.936	0.879	0.957	0.917	0.931	0.871
Competitive Pressure (CP)	0.905	0.827	0.882	0.791	0.910	0.835
ERP Use (ERPU)	0.876	0.779	0.878	0.782	0.868	0.767
Collaboration (CO)	0.881	0.712	0.902	0.754	0.873	0.696
Analytics (AN)	0.870	0.690	0.915	0.782	0.856	0.665
ERP Value (ERP V)	0.881	0.652	0.886	0.664	0.880	0.648

Table II. PLS factor loading, composite reliability, and average variance extracted of full and country samples

In short, our measurement model satisfies convergent validity criteria. Consequently, the constructs developed can be used to test the conceptual model and its hypotheses.

We tested the conceptual model by using both the full sample and the sample split between Portugal and Spain. Figure 2 shows the path coefficients and t-statistics (in parentheses) derived from bootstrapping (300 resamples), as well as the R² values for dependent constructs.

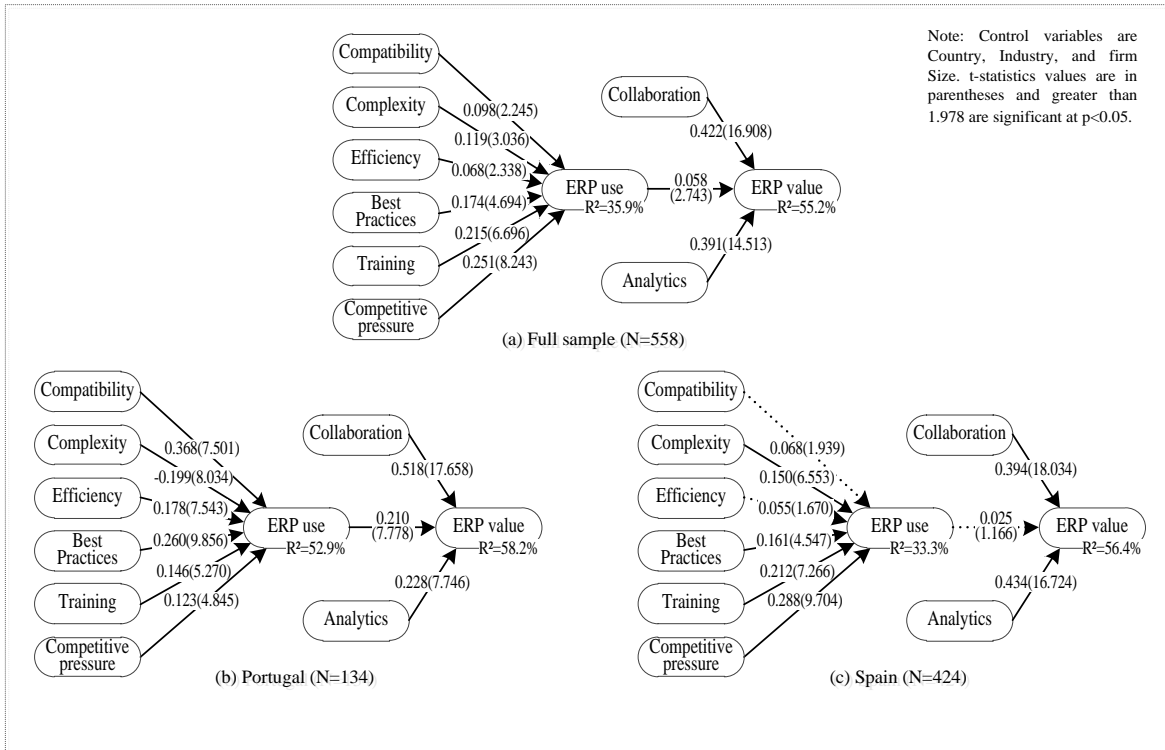


Figure 2. Path models of full sample and by country

The analysis of hypotheses for the full sample was based on the examination of the standardized paths shown in Figure 2(a). For ‘ERP use’, all six DOI determinants; compatibility, complexity, efficiency, best-practices, training and competitive pressure, have positive and statistically significant paths leading to the dependent construct. Although the path associated with complexity is statistically significant, it does not have the negative sign that we expected. Therefore, all hypotheses (except H2) dealing with ‘ERP use’ are supported. In addition, the model shows a significantly positive link from use to value (0.058), thus supporting H7. Collaboration and analytics are also shown to have significantly positive associations with ‘ERP value’; hence, H8 and H9 are supported. To assess model fit, we present R² values in Figure 2 (a), which indicates how well the antecedents explain the dependent construct. An examination of the R² values shows that all six DOI determinants explains the variability of ‘ERP use’ in 35.9%, and ‘ERP use’, collaboration and Analytics determinants explain the variability of ‘ERP value’ in 55.2%, suggesting a good fit for the model.

The analysis of hypotheses on the Portuguese and Spanish subsamples was also based on the examination of the standardized paths shown in Figures 2(b) and 2(c), respectively. In the Portuguese subsample, for ‘ERP use’, although complexity has a negative path while the other five factors have positive paths, all six DOI determinants are statistically significant. Thus, H1 to H6 regarding ‘ERP use’ are supported. In addition, the model indicates a strong link from ‘ERP use’ to ‘ERP value’ (H7). Although collaboration (H8) has a stronger relationship (0.518) with ‘ERP value’ than analytics (H9), both H8 and H9 are supported. Regarding the Portuguese subsample, based on this model 52.9% of the ‘ERP use’ variability was explained by six determinants, and 58.2% of the ‘ERP value’ variability was explained by three determinants.

In the Spanish subsample, for ‘ERP use’, although all six DOI determinants are positive, only four are found to be significant; compatibility and efficiency are insignificant. Complexity was expected to be negative and therefore, H4, H5, and H6 for ‘ERP use’ are supported. The model shows a not significant link between ‘ERP

use' and 'ERP value', hence H7 is not confirmed. As in the Portuguese subsample, the Spanish shows a significantly positive association of collaboration and analytics with 'ERP value'. Hence, H8 and H9 are supported. For Spain, best-practices, training, and competitive pressure explain the variability of 'ERP use' in 33.3% and, 'ERP use', collaboration, and analytics explain the variability of 'ERP value' in 56.4%.

In a deeper analysis, we tested the differences between the path coefficients across the Portugal and Spain subsamples. Table III shows that regarding 'ERP use'; training has no statistically significant differences ($p > 0.10$) between countries, being equally important for both Portuguese and Spanish firms. Whereas best-practices, compatibility, and efficiency are more important factors to Portuguese firms, competitive pressure is more important to Spanish firms. Moreover, complexity is found to be an important inhibitor for Portuguese firms and a facilitator for Spanish. Regarding 'ERP value'; whereas 'ERP use' and collaboration are more important for Portuguese firms, analytics is more important to Spanish firms.

	<u>Portugal</u>		<u>Spain</u>		t-Stat.	p (2-tailed)
	Path coeff.	SE from bootstrap	Path coeff.	SE from bootstrap		
Compatibility -> ERP Use	0.368	0.049	0.068	0.035	4.989	0.000
Complexity -> ERP Use	-0.199	0.025	0.150	0.023	-10.359	0.000
Efficiency -> ERP Use	0.178	0.024	0.055	0.033	3.021	0.003
Best Practices -> ERP Use	0.260	0.026	0.161	0.035	2.260	0.024
Training -> ERP Use	0.146	0.028	0.212	0.029	-1.625	0.104
Competitive -> ERP Use	0.123	0.025	0.288	0.030	-4.214	0.000
ERP Use -> ERP Value	0.210	0.027	0.025	0.021	5.383	0.000
Collaboration -> ERP Value	0.518	0.029	0.394	0.022	3.409	0001
Analytics -> ERP Value	0.228	0.029	0.434	0.026	-5.269	0.000

Table III. Results of pooled error term t-Tests by subgroup

Overall, the above results provide support for the cross-country differences in the determinants shaping ERP use and value in which firms adopt IT, thereby supporting Hypothesis 10.

6. Discussion

The purpose of this paper is to identify the determinants that explain ERP post-adoption with regard to usage and value and to determine the magnitude of variations across Portugal and Spain. Empirical results support our theoretical model, and all hypotheses have been tested on full sample and subsamples. Both academic and managerial implications are discussed below.

Full sample

As indicated by their significant and positive paths in Figure 2(a), amongst the DOI determinants, competitive pressure is found to have the most significant impact on the degree of 'ERP use', followed by training and best-practices. That is, firms facing greater competitive pressure tend to achieve a greater extent of 'ERP use', as do firms with better trained users, as well as using ERP systems with standard best-practices. Our study provides evidence that system compatibility and transactional efficiency are important drivers for system usage. That is, as daily operations are more and more managed through ERP use, and compatibility issues are resolved, ERP becomes more stable, increasing the reliability and effectiveness for its usage, thus becoming a necessity.

Contrary to the conclusions of Bradford and Florin (2003), Kositanurit *et al.* (2006), and Chang *et al.* (2011), and our predictions, our results reveal a positive effect of system complexity on 'ERP use'. It has been widely

believed that complexity of business applications is an inhibitor to use, but our results provide evidence that for Spanish firms system complexity is not an inhibitor, such as it is for Portuguese firms.

As shown in Figure 2(a), the 'ERP use' and 'ERP value' relationship is found to be a significant and positive link from use to value, supporting our research design, in which use explains the value, in accordance with Devaraj and Kohli (2003) and Zhu and Kraemer (2005).

Both collaboration and analytics capabilities are found to be a significant and positive links to 'ERP value'. As discussed in the "hypothesis to explain value" subsection (3.2), while collaborating with colleagues, system, suppliers, partners, and customers increase productivity, analytics provides greater business insight for better decision making processes. As a result, these two ERP enhanced capabilities help firms to improve performance because they are firm specific, difficult to imitate, and less mobile across firms, which is consistent with the RBV theory.

Differences between Portugal and Spain.

Our study finds that for Portuguese SMEs the ERP value relies greatly on the capacity of users to collaborate to meet service levels, mainly because transactional data become visible to the supply chain, decreasing the bullwhip effect. Since quality of the data (and thus also the quality of its ramifications) is largely dependent on using the system correctly, the 'ERP use' is also perceived as an important determinant for ERP value. Subsequently, as data become available and transformed into business information, allowing reporting, analytics capabilities are considered alongside as an important factor of ERP value. For Spanish SMEs the ERP value is composed largely of system analytics capabilities to make full use of operational data, and generate more detailed reports to support decision-making and resource planning in an improved manner - followed by collaboration, to serve new possibilities for using information to improve transparency and business processes.

Contrarily to Portuguese SMEs, the greater ERP use amongst Spanish firms is not perceived as an important factor to generate value from ERP. This difference might be explained by the fewer number of years in which Portuguese firms have been using ERP; whereas the Portuguese subsample shows that 70% of firms have been using ERP systems for less than 5 years, the Spanish subsample shows 40%. (Table I). That is, utilizing the ERP logic for more years, the perception of 'ERP use' upon 'ERP value' drops in importance next to collaboration and analytics capabilities. In line with Hakkinen and Hilmola (2008) the perception on ERP success usage drops from the 'shakedown' phase (when the system was just adopted) to post go-live phase (a few years after the system start been utilized). Moreover, Buonanno *et al.* (2005) state that ERP starters confer more value to collaboration because it is often connected to the organizational enhancements, whereas firms using ERP for more years confer to fully exploit data analytically. Thus, whereas for Portuguese firms organizational factors such as 'ERP use' have a great impact on value, for Spanish firms it loses importance to factors such as business analytical information.

With regards to 'ERP use', although competitive pressure, training, and best-practices are significant factors for countries, compatibility, complexity, and efficiency importance differ (Figures 2(b) and 2(c)). The underlying rationale would be that the number of years using the system shapes 'ERP use'. This conclusion might be explained through cross-country analysis.

First, although ERP best-practices (using standard protocols and few customizations) is more fitted to IS starters (Buonanno *et al.*, 2005, Nicolaou and Bhattacharya, 2006), in connection with users trained through key-users and/or help-on-line tools, both are important drivers for ERP use in both shakedown and post go-live phases. In line with Hakkinen and Hilmola (2008), poor helpdesk support and training (to reduce system complexity and create users skills), and customizations were the main barriers to best possible use of the ERP. Second, although competitive pressure is statistically significant for both Portuguese and Spanish firms, it is stronger for Spanish firms. A possible explanation is that Spanish firms have been using ERP for more years, revealing that competitive pressure is a subject where analytics plays a critical role in gaining business advantages.

Third, although compatibility and efficiency have positive paths for both countries, they are not statistically significant for Spanish firms. This can be explained by the importance that Portuguese firms confer to

technological characteristics such as compatibility with other hardware and software, and transactional efficiency (for fast and real-time data quality, avoiding errors, higher inventories, lower profits, and non-value-added work), which are dependent on the system stabilization throughout the shakedown phase (Hakkinen and Hilmola, 2008; Gattiker and Goodhue, 2005).

Finally, while complexity is significant for both countries, it has a negative impact for the Portuguese firms. That is, since characteristics such as familiarity with ERP could depend on use over time, ERP starters generally have more complexity worries in manipulating the system in effective ways and obtaining worth from it. In contrast, as Spanish firms could be more familiar with ERP logic, they do not perceive system complexity as an inhibitor for ERP use.

Managerial implications

These results offer a useful framework for managers to assess post-adoption cross-country variations in usage and value of ERP. Both countries' managers should maintain priority on training programmes as well as using the ERP standard best-practices; these factors will contribute to increase skills and familiarity with the system. With the same priority, Portuguese managers should closely manage the compatibility with legacy systems and plan activities concerned with system efficiency in order to achieve greater usage and quality data. In order to create competitive advantages, both countries' managers should define strategies based on the fact that as ERP diffuses through usage and becomes a necessity to business process and organizational coverage, the competitive pressure infuses the strategic exploitation of the ERP transaction data into high value processes that are supported by new IT analytical functionalities and capabilities in areas such as collaboration throughout the supply chain. Our study also offers implications for IT industry/services. System complexity and business analytics functionalities have emerged as important factors for ERP use and value in such a way that for Portuguese SMEs familiarity is an important factor, while analytics capabilities are more important for Spanish SMEs, which implies different implementation methodologies and support contracts, alongside developing friendly front-end functionalities that extend both collaboration and analytics, yet based on standard best-practices.

Research implications

We believe this study offers implications for other researchers as well. First, we have shown that the proposed research model in Figure 1 is a useful theoretical framework for explaining determinants that affect the ERP use and value across countries and may be extended to other countries. Second, we have developed several constructs, including efficiency, which have passed convergent validity testing, and could be used in future studies. Third, supported with theory and empirical data, we have categorized two IT-enhanced capabilities (collaborations and analytics) and analysed their relative significance for ERP value. The result could serve as a theoretical base for studying additional sources of value creation derived from technology innovations.

Limitations and future work

This paper has some limitations that may form the starting point for further research. First, although our empirical results show that relationships exist among the determinants, we cannot speak empirically to the issue of whether value is sustained, because this requires a longitudinal study, so longitudinal studies could be developed. Second, although our study shows evidence that the determinants of use and value vary across-countries in association with the number of years using ERP, we cannot speak empirically to the issue of whether the maturity stages play a role, because this would require an adoption process life-cycle study (Holland and Light, 2001). An interesting different direction could be to study the maturity stages of ERP. Third, although data cover industry types, some biases may have been introduced. Perhaps different industries have different operating characteristics and environments, and the factors related to ERP use and value may differ accordingly (Oliveira and Martins, 2010a). Consequently, we encourage further studies that compare industries.

7. Conclusion

Consistent with DOI and RBV, we developed and empirically evaluated a research model for assessing ERP use and value at the firm level. While these are usually studied separately, our study proposes that use and value are closely associated for the post-adoption stages. Besides being the first model applied to Iberian SMEs, our study contributes to the literature by moving beyond dichotomous “adoption versus non-adoption” linking actual usage to value creation, and adds transactional efficiency and collaboration as important determinants for Portuguese firms, as well as business analytics, but more important for Spanish firms. For ‘ERP’ use, our study has examined six DOI determinants; whereas competitive pressure, training and best-practices are important to both Portuguese and Spanish firms, cross-country analysis also shows complexity to be an important inhibitor for ‘ERP use’ among Portuguese firms, but a facilitator for Spanish. In addition, while for Portuguese, compatibility and efficiency are significant, they are not for Spanish. For ‘ERP value’ (and consistent with RBV), our study demonstrates that the degree of ‘ERP use’ and IT-enhanced capabilities such as collaboration and analytics, contribute to value creation from ERP. Moreover, our study reveals that for Portuguese firms ‘ERP value’ is mainly explained by ‘ERP use’, collaboration, and analytics, whereas for Spanish firms ‘ERP value’ is mainly explained by collaboration and analytics capabilities. Finally, our study exposes that both countries’ SMEs are not using ERPs as a transaction processing system alone, but also as a front-end application.

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Appendix A. Items measurements

Variable	Indicators	Literature support
Using a five-point scale, where 1 means 'low' and 5 'high', respondents* were asked to rate their perception.		
Compatibility	Please rate the degree to which... CB1 ... your ERP system is compatible with others' software. CB2 ...your ERP system is compatible with others' hardware. CB3... your ERP system is compatible with others' networks.**	Bradford and Florin ,2003; Elbertsen <i>et al.</i> , 2006.
Complexity (reverse code)	According to users' interaction with ERP, please rate... CX1... how easy it is for them to learn the system.** CX2 ...the intuitiveness of the system. CX3 ...how comfortable they feel using it.	Cooper and Zmud, 1990; Kositanurit <i>et al.</i> , 2006; Chang <i>et al.</i> , 2011
Efficiency	According to users' interaction with ERP, please rate the... EF1 ...effectiveness in executing repetitive tasks. EF2 ...effectiveness of user interface. EF3 ...speed and reliability of system.	Rajagopal <i>et al.</i> , 2002; Bendoly <i>et al.</i> , 2004; Gattiker <i>et al.</i> , 2005
Best Practice	According to ERP standard package (best-practices) fitting firm's processes, please rate the degree... BP1 ...to which users set up the application. BP2 ...to which one can map workflows based on local requirements (such as VAT, intercompany posting). BP3 ...of system adaptability to business needs.	Chou and Chang, 2008; Wenrich and Ahmad, 2009; Maguire <i>et al.</i> , 2010
Training	Please rate the degree to which training programme make sure users ... TN1 ...are being trained on the system.** TN2 ...understand the content training material. TN3 ...navigate through the topic formats applied to daily tasks.	O'Leary, 2000; Bradford and Florin, 2003; Maguire <i>et al.</i> , 2010
Competitive Pressure	Please rate the degree to which ... CP1 ... your firm has experienced competitive pressure to use ERP. CP2 ... your firm would have experienced competitive disadvantage if ERP had not been adopted.* CP3 ... the ERP usage in your firm's competitors affects your landscape market.	Bradford and Florin, 2003; Zhu <i>et al.</i> , 2004; Oliveira and Martins, 2010b
ERP Use	According to ERP usage how... ERPU1 ...many employees use the system daily? (#)** ERPU2 ...much time per day do employees work with the system? (%) ERPU3 ...many reports are generated per day? (%)	Bradford and Florin, 2003; Devaraj and Kohli, 2003; Zhu and Kraemer, 2005
Collaboration	According to users, please rate the degree of how ease for them ... CO1 ... collaborate with colleagues. CO2 ... collaborate with the system. CO3 ... communicate with suppliers, partners, and customers.	Calisir and Calisir, 2004; Gattiker and Goodhue, 2005; Ruivo and Neto, 2010
Analytics	According to ERP system, please rate the degree of... AN1 ...comprehensive reporting (KPIs, Dashboards, etc.). AN2 ...real-time access to information. AN3 ...data visibility across departments.	Davenport <i>et al.</i> , 2007; Chiang <i>et al.</i> , 2009; Ruivo and Neto, 2010
ERP Value (firm performance)	Please rate the degree of ERP impact on... ERPV1 ...user satisfaction. ERPV2 ...individual productivity. ERPV3 ...customer satisfaction. ERPV4 ...management control.	Bradford and Florin, 2003; Devaraj and Kohli, 2003; Zhu and Kraemer, 2005; Shahin and Ainin, 2011

* Respondents types were: CEO, owner, IT/IS manager, Finance manager, Sales manager and Manufacturing manager

** CB3, CX1, TN1, CP2, and ERPU1 question-items were excluded after PLS model estimation due to low loadings.