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Enterprise resource planning and customer relationship management value

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Abstract

Purpose – The purpose of this paper is to develop and test a theoretical model to measure the impact of enterprise resource planning (ERP) and customer relationship management (CRM) systems and moderating relationships of system and process integration on business value.
Design/methodology/approach – ERP and CRM systems are analysed with the resource-based view theory and measured by their impact on business value, having in consideration the moderation of system and process integration. The model was tested and analysed with data collected by Microsoft, from firms that have adopted both ERP and CRM systems in their organisation.
Findings – ERP system is found to be an important asset to business value, but CRM systems' impact on business value is found to be not significant. System integration as moderator of ERP or CRM system is found to be not significant but has a positive and significant impact on business value. For process integration, the study finds that it is significant only when moderating the CRM system variable.
Research limitations/implications – The model shows that the moderating effects of system and process integration are important variables for understanding the joint business value of ERP and CRM.
Practical implications – Adopting an ERP system and ensuring system integration provides a direct impact on business value. In order for a CRM system to have a positive impact on business value, process integration with ERP system must be ensured.
Originality/value – This study provides new knowledge on how ERP and CRM systems used together may positively influence value from IT investments, and how systems integration and process integration provide business value.

Keywords CRM, ERP, Value, Process integration, System integration
Paper type Research paper

1. Introduction

Enterprise resource planning (ERP) systems have been applied by many firms of varying size around the world as a key part of their organisational architecture. ERP systems support day-to-day business operations and decision-making processes (Gattiker and Goodhue, 2005; May *et al.*, 2013), and are expected to provide seamless integration of processes across functional areas (Mabert *et al.*, 2003). However, these IT resources streamline and integrate internal business processes to improve efficiency only within a firm's boundaries (Davenport, 1998).

Customer relationship management (CRM) systems have exploded on the enterprise space in recent years, and some studies claim that they are the ultimate solution to the information exchange problem among firms (Gartner, 2013; Extraprise, 2008; Chang *et al.*, 2014). CRM extends the original value proposition of ERP, allowing firms to build interactive relationships with their customers and bring together their previously separated information at very low cost (Payne and Frow, 2006; Iriana and Buttle, 2006).

Research states that CRM systems encompass the external part of the extended enterprise, and ERP encompasses the internal part (Gartner, 2013; Extraprise, 2008; Alshawi *et al.*, 2011). That is, while CRM applications extract customer information from customer facing processes, ERP applications leverage the information to configure product offerings, scheduling, and fulfilment processes (Hitt *et al.*, 2002). As more firms realise that they need to know their customers very profoundly in order to compete or survive, integrating CRM with ERP becomes a critical topic (Payne and Frow, 2005; Ryals, 2005). Integrated CRM and ERP

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systems automatically communicate customer and process-related information to each other (Rai *et al.*, 2006), increase interdepartmental connectedness, facilitate the dissemination of market intelligence amongst multiple departments and locations, and improve the entire organisation's responsiveness to consumer demands (Liu *et al.*, 2013).

Moreover, some researchers suggest that IT value is better captured when taking into consideration moderator relationships on the link between IT resources and business value (Liu *et al.*, 2013; Mishra and Agarwal, 2010). Although few, some IS researchers have identified ERP and CRM integration as one of the most important fields for future IT value research (King and Burgess, 2008; Alshawi *et al.*, 2011; Davenport, 1998; Kim *et al.*, 2015; Willis and Willis-Brown, 2002; Liu *et al.*, 2013; Melville *et al.*, 2004) and claim that system integration is a key factor that shapes how IT is applied to digitise business processes and generate value. Some researchers point out that business process integration plays an important role for return on investment on improvements in both ERP (Roh and Hong, 2015; Narayanan *et al.*, 2011; Samaranayake, 2009) and CRM (Osarenkhoe and Bennani, 2007; Light, 2003; Nguyen and Mutum, 2012; Liu *et al.*, 2013).

Motivated by these issues, this study develops and tests a theoretical model grounded in a well-established IS theory, resource-based view (RBV). We investigate the impact of the joint ERP and CRM systems value by taking into consideration the moderating relationships of system and process integration. In doing so, we contribute to the IT value literature by examining the complementarity value of the integration of these two resources. Our work focusses on answering the following research questions:

RQ1. Are ERP and CRM systems drivers of business value?

RQ2. Are systems and processes integration drivers of business value?

RQ3. Do systems and processes integration work as moderators of ERP and CRM systems in business value creation?

The remainder of the paper is organised as follows. In Section 2, we provide a literature review on ERP and CRM business value, followed by an overview of RBV theory of the firm that underpins our research model. In Section 3, we present the proposed research model and hypotheses. In Section 4, we explain the research methodology and operationalise the variables. Section 5 has the results and analysis. In Section 6, we discuss the results, present the managerial implications, contributions, limitations, and directions for future work. In the last section we present the concluding remarks.

2. Literature review

The purpose of this section is to position our literature review with regard to existing knowledge about the ERP and CRM value. More precisely, we first review the three streams of published studies that build our knowledge: the ERP business value, the CRM business value, and the role of systems and process integration on business value. Then we set the RBV theory of the firm as the theoretical framework for linking the ERP and CRM to business value.

2.1 The ERP business value

In reviewing ERP studies, we were able to find seven literature review publications: Esteves and Pastor (2001) analysed 189 papers, Shehab *et al.* (2004) analysed 76, Botta-Genoulaz *et al.* (2005) analysed 80, Cumbie *et al.* (2005) analysed 49, Esteves and Bohórquez (2007) analysed 640, Schlichter and Kraemmergaard (2010) analysed 885, and Huang and Yasuda (2016) analysed 86 papers. These studies reveal the rich variety and practice of ERP systems in different firms. Still, the authors claim that ERP research is lacking studies addressing the ERP

business value. In this line, our review of earlier research that is focussed on the relationship of ERP with business value reveals three main clusters of studies:

(1) The first investigates tangible areas of ERP in firms' performance, basically following the "IT productivity paradox" paradigm (Dedrick *et al.*, 2003). Traditional cost measures such as direct operating costs (ROA, ROE, COGS, SG&A, and profit margin) (Nicolaou and Bhattacharya, 2006, 2008; Nicolaou, 2004), inventory levels, and cash management (Hitt *et al.*, 2002; Aral *et al.*, 2005) are used.

(2) The second reports that most of the business value in ERP use resides in intangible areas such as increased interactions across the enterprise, quick response time for information, availability and quality of information (Ranganathan and Brown, 2006; Mabert *et al.*, 2003), improvements in communications, user satisfaction, and management control (Rhodes *et al.*, 2009; Gattiker and Goodhue, 2005; Zhang *et al.*, 2005; Bradford and Florin, 2003), improvements in coordination between different units, cost efficiency, and differentiation (Hitt *et al.*, 2002; Nicolaou and Bhattacharya, 2006; Al-Mashari, 2002), efficiency, enhanced process integration, automation, and optimisation (Roh and Hong, 2015; Narayanan *et al.*, 2011; Samaranayake, 2009; Finney and Corbett, 2007).

(3) A third cluster addresses tangible and intangible complementarity measures and investigates a positive relationship between ERP and business value (Ruivo *et al.*, 2012, 2015; May *et al.*, 2013; Willis and Willis-Brown, 2002).

However, according to several authors (Huang and Yasuda, 2016; Ram *et al.*, 2014; Ruivo *et al.*, 2012; Nicolaou and Bhattacharya, 2006; Velcu, 2007) ERP would have a better impact on business value when complementing other IT resources. These findings resonate with earlier work by Laframboise and Reyes (2005) and Holland and Light (2001), who suggest that ERP may not be sufficient by itself to have a great impact on business value, but can provide the platform on which other resources can excel and thereby create a unique system that greatly boosts business value.

2.2 The CRM business value

In reviewing CRM studies, we were able to find six literature review publications: Romano and Fjermestad (2003) analysed 369 articles, Ngai (2005) analysed 205 papers, Paulissen *et al.* (2007) analysed 510 papers, Ngai *et al.* (2009) analysed 87 papers, Wahlberg *et al.* (2009) analysed 468, and Soltani and Navimipour (2016) analysed 27 papers. These studies reveal the rich variety and practice of CRM systems in different firms, but the authors claim that CRM research is lacking studies addressing the CRM business value. In this line, our review of earlier research that is focussed on the relationship of CRM with business value reveals three main clusters of studies:

(1) The first assesses the CRM value through tangible measures such as the success at generating revenues from new products, reduction in cost of transacting with customers, level of repeat purchase (Payne and Frow, 2005, 2006; Iriana and Buttle, 2006; Dong and Zhu, 2008; Alshawi *et al.*, 2011), and increase in return on assets, return on sales, and return on equity (Boulding *et al.*, 2005; Hillebrand *et al.*, 2011; Reinartz *et al.*, 2004).

(2) In the second cluster, CRM creates intangible value for both the firm and its customers through the appropriate system's usage, data, and customer knowledge (Alshawi *et al.*, 2011; Chen and Popovich, 2003; Payne and Frow, 2006). It brings together people, processes, technology, and organisational capabilities to ensure connectivity between the company, its customers, and collaborating firms (Light, 2003; Liu *et al.*, 2013; Nguyen and Mutum, 2012; Osarenkhoe and Bennani, 2007).

(3) A third cluster assessing both tangible and intangible measures reports efficiency gains in the front-office process (Albert *et al.*, 2004; Jayachandran *et al.*, 2005; Karimi *et al.*, 2001; Minami and Dawson, 2008; Chang *et al.*, 2014; Kim *et al.*, 2015), and improved customer information in the back-office process (Ernst *et al.*, 2011; Mithas *et al.*, 2005; Padmanabhan *et al.*, 2006; Liu *et al.*, 2013; Bull, 2003; Pedron *et al.*, 2016).

However, several researchers have expressed concerns about the lack of research on the combination of IT resources such as CRM with ERP systems that deliver most business value (Mithas *et al.*, 2011; Aral *et al.*, 2005; Aral and Weill, 2007; Liu *et al.*, 2013; Alshawi *et al.*, 2011; Chen and Popovich, 2003; Hendricks *et al.*, 2007).

2.3 The role of systems and process integration on business value

According to several researchers (Rai *et al.*, 2006; Hsu, 2013b; Barki and Pinsonneault, 2005; Ranganathan and Brown, 2006), the benefits of IT integration of business applications such as ERP and CRM can be attained on two levels: systems integration and process integration.

Systems integration refers to the degree of linkages between different computer-based information systems and databases. It is the process of linking together different software applications such as the ERP and CRM to work in a coordinated manner (Melville *et al.*, 2004; Liu *et al.*, 2013; Francalanci and Morabito, 2008). The business value of systems integration is data quality and data integration. Firms can work more intelligently with data because it eliminates double data entry, increases data accuracy, and data become visible across the firm (Ram *et al.*, 2013; Hsu, 2013b; Bharadwaj *et al.*, 2007; Laframboise and Reyes, 2005).

Process integration represents the extent to which the business processes of two departments are tightly coordinated and standardised through the firm's information system (Barki and Pinsonneault, 2005; Chen and Popovich, 2003; Francalanci and Morabito, 2008). The business value of ERP and CRM process integration is that integrated myriad business processes save time and expense. Firms can then make decisions more quickly with fewer errors and greater insights (Samaranayake, 2009; Narayanan *et al.*, 2011); more precisely, automate common business processes such as contact and account integration, product integration, order and quote management, and order/invoice tracking (Roh and Hong, 2015; Nguyen and Mutum, 2012; Osarenkhoe and Bennani, 2007).

Systems integration is a prerequisite and facilitator of business process integration. However, two departments or subsidiaries might both achieve a high level of system integration, but their process integration level might vary due to a reluctance to share information (Chen and Popovich, 2003; Hsu, 2013b; Rai *et al.*, 2006). Literature suggests that it is only when system and process integration are measured in conjunction with a firm's IT resources that these will have a positive impact on business value (Rai *et al.*, 2006; Ranganathan and Brown, 2006; Dong and Zhu, 2008; Boulding *et al.*, 2005; Hendricks *et al.*, 2007; Hsu, 2013b).

2.4 The RBV and business value

A potential framework for extending the theoretical basis of IT value is the RBV of the firm, which is rooted in economics and management rationales (Melville *et al.*, 2004). When the firm resources are valuable, non-imitable, and non-substitutable, they can explain the differences in business value (Rhodes *et al.*, 2009; Zhu and Kraemer, 2005). The RBV has been used in the IS literature to explain IT business value, in which firm-specific sets of resources determine the firm's performance (Zhu and Kraemer, 2005; Uwizeyemungu and Raymond, 2012; Ruivo *et al.*, 2012, 2015). Some researchers have emphasised that an IT resource, such as ERP, is likely to affect business value only when it is deployed to create unique integrative complementarities with other IT resources, such as CRM systems (Rai *et al.*, 2006; Wade and Hulland, 2004). Integrative complementarity represents the enhancement of resource value, because a resource produces greater returns when

integrated with another resource, than by itself (Wade and Hulland, 2004; Melville *et al.*, 2004; King and Burgess, 2008).

Although business components such as ERP and CRM systems that go into the firm's infrastructure are commodities-like, the process of integrating these components makes a firm-specific system difficult to be substituted and understood by competitors (Bharadwaj, 2000; Zhu and Kraemer, 2005; King and Burgess, 2008).

Upon review of earlier research streams, we conclude that while the reported studies have expanded the business value of ERP and CRM understanding, the results look at these systems only separately. No study was found that assesses the joint value of ERP and CRM grounded in the RBV theory. The present study uses the RBV as a frame of reference to develop a theoretical model to understand the extent to which ERP and CRM integration contributes to business value. We next define the model variables and hypotheses.

3. Research model and hypotheses

Focussing on the process-oriented view about the business value creation of IT (Zhu and Kraemer, 2005; Picoto *et al.*, 2014), we advance the above stream and develop a research model to understand the impact of ERP and CRM systems moderated by system and process integration on business value. Our research model is illustrated in Figure 1.

We theorise that "Business value" is driven by four antecedent variables: ERP system, CRM systems, system integration, and process integration, and that it is moderated by two variables: system integration and process integration. These variables are hypothesised to measure the impact of ERP and CRM integration on business value. Business value is a second-order variable of three dimensions: impact on operations, impact on procurement, and impact on sales, which are grounded in the value chain analysis that has been broadly used in the IS literature to study the business value of IT (Zhu and Kraemer, 2005; Picoto *et al.*, 2014). We next present the hypotheses of the model.

3.1 Hypotheses for direct relationships

Taking into consideration the theoretical background presented above, whereas ERP systems focus on internal process and are expected to affect a firm's internal operations by decreasing internal costs (Gattiker and Goodhue, 2005), CRM systems focus on external, intra-firm

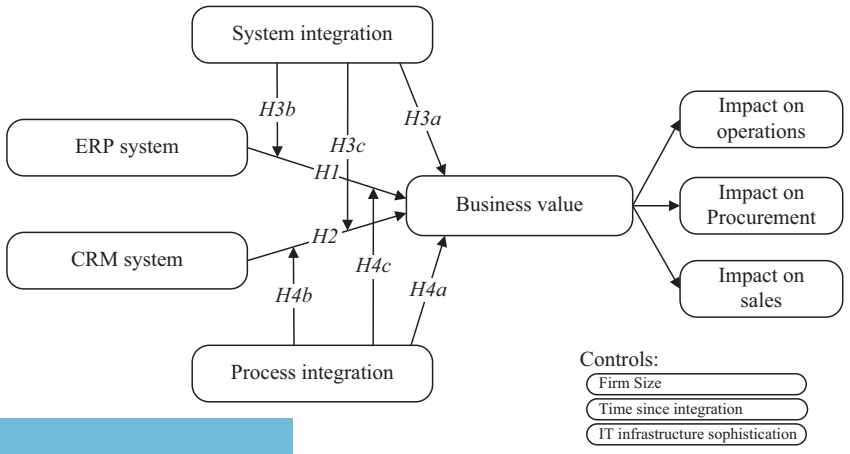


Figure 1.
Research model to assess the impact of ERP and CRM value on business value

process efficiency and effectiveness by decreasing coordination costs and reaping the benefits of customer relationships (Goodhue *et al.*, 2002). In this line we postulate the following:

H1. Firms with greater ERP system functionality are more likely to generate higher business value.

H2. Firms with greater CRM system functionality are more likely to generate higher business value.

Integrating ERP and CRM might be a technically complex process. An ERP system generally embodies firm's business logic, in which the routines, rules, and procedures such as procurement, fulfilment, and approvals are made over electronic transactions that are expanded and enhanced when technically tied with other systems (Hsu, 2013b; Gattiker and Goodhue, 2005). CRM functions must generally adapt to the business logic, and therefore a successful integration between ERP and CRM systems is considered to be valuable, heterogeneously distributed, difficult to be imitated, and difficult to be substituted, which is in accordance with RBV rationales (Gattiker and Goodhue, 2005; Goodhue *et al.*, 2002; Liu *et al.*, 2013). In this line we postulate the following:

H3a. Firms with greater system integration are more likely to generate higher business value.

H4a. Firms with greater process integration are more likely to generate higher business value.

3.2 Hypotheses for moderator relationships

Several earlier studies consider that moderating relationships best explain the IT integration value (Liu *et al.*, 2013; Melville *et al.*, 2004; Boulding *et al.*, 2005). In addition to incorporating whether ERP and CRM are integrated into the entire value chain (as proxy) we also consider that there are two moderators that will reinforce the positive relationship between ERP and CRM systems and the business value of the firm's information system: system integration and process integration. Whereas system integration is the IT component that creates the correct links between different information systems and databases, process integration is the extent to which the business processes of the two systems are tightly linked and standardised into what could be described as a single information system. Given that ERP and CRM are strategic initiatives that involve both business and IT, their impact on a business value should also be examined in the systems and business process settings in which the firm operates specifically, because it is a richer field in which to build competitive advantages, which is consistent with RBV rationales. Hence, we postulate the following four hypotheses:

H3b. System integration moderates the relationships of ERP system on business value, such that it is stronger amongst the firms with high system integration level.

H3c. System integration moderates the relationships of CRM system on business value, such that it is stronger amongst the firms with high system integration level.

H4b. Process integration moderates the relationships of ERP system on business value, such that it is stronger amongst the firms with high process integration level.

H4c. Process integration moderates the relationships of CRM system on business value, such that it is stronger amongst the firms with high process integration level.

4. Research methodology

To test our research model, a survey instrument was designed to collect data on each of the variables in the model.

4.1 Data

In accordance with Zhu and Kraemer (2005), theory development usually progresses to empirical testing, and hence a questionnaire was designed to investigate the ERP and CRM business value (see Table AI). A web-based survey was developed from the literature by choosing appropriate items. A group of five established academic researchers reviewed the instrument for content validity (Venkatesh *et al.*, 2012). The initial questionnaire was pilot tested in 50 firms, randomly selected from Microsoft database using both ERP and CRM systems, in Lisbon area (15) and Madrid area (35), to assess any item's difficulty or ambiguity and to test the reliability and validity of the scales. The 30 firms that responded (11 from Lisbon and 19 from Madrid) were contacted for a telephone interview to ask for their opinions on the questionnaire and to identify any items that they found to be confusing or ambiguous. Some items were revised for clarity. This phase provided preliminary evidence on the reliability and validity of the scales.

In accordance with Hwang (2005), a socio-technical approach of enterprise systems involves the integration of business process and technical aspects such as systems integration to overcome uncertainty. Moreover, Hofstede's (2001) cultural dimensions study concluded that Portugal and Spain (composing the Iberian region) are the countries with the highest uncertainty avoidance rate. We therefore selected these two countries as a proxy (Leidner and Kayworth, 2006). It should be noted that the goal of studying these two countries was to understand the relationships of the proposed model. Careful attention was given to ensure the validity and reliability of the findings. That is, the sample was carefully and systematically identified; primary data were used; pilot-test was developed prior to the web-survey; data were stratified by industry area and firm size, and collected and stored in a systematic manner; and the results were revised, verified, and analysed with advanced statistics (Zhu and Kraemer, 2005). Our future research will be to test the model for firms in different areas and from different countries.

Firms eligible for inclusion in the study were selected from Microsoft database. After filtering by country (Portugal and Spain) and using both ERP and CRM systems in their daily business activities, we obtained a final list with 400 firms. In total, 150 firms from Portugal and 250 from Spain received the web-survey in September 2015 from Microsoft. In order to increase content validity and response rate, we indicated that the respondents should be individuals with ERP and CRM knowledge within the firms, and we offered to share the results of the research to improve the response rate and increase content validity. To the non-respondents a follow up e-mail was sent three weeks after the first e-mail. Totally, 125 valid responses were returned (93 early and 32 later), resulting in a response rate of 31.25 per cent. To test non-response bias, we compared early and late respondents groups based on the Kolmogorov-Smirnov (K-S) test and found no statistically significant differences between the two groups (Ryans, 1974). We used Harman's one-factor test (Podsakoff *et al.*, 2003) to examine the common method bias, showing that the first factor explains 37.6 per cent of the variance. This means that none of the factors explain the majority of the variance. To ensure the generalisation of the survey results, the sampling was stratified by firm size, by industry type (financial services, retail, manufacturing, professional services, information technology, and utilities), and by ERP and CRM system's vendor. Table I shows the characteristics of the sample and of the respondents, such as industry and role, which indicate that they were qualified to speak about the firm's ERP and CRM value, suggesting the good quality of the data.

4.2 Operationalisation of the variables

The variables and measurement items were adapted from previously validated measures or developed on the basis of the literature review discussed in the previous section. Respondents were asked to rate their perceptions. The variables were measured on a five-point quantitative scale, in which 1 means "low" and 5 "high".

Characteristics	*n*	%
Country		
Spain	64	51.2
Portugal	61	48.8
Industry type		
Professional services	40	32.0
Retail	31	24.8
Manufacturing	23	18.4
Financial services	17	13.6
Information technology	8	6.4
Utilities	6	4.8
Respondent's role		
IT/IS manager	32	25.6
CEO/owner	30	24.0
Sales manager	29	23.2
Manufacturing manager	13	10.4
Logistics manager	11	8.8
Finance manager	10	8.0
Annual turnover (€)		
< 1 M	20	16.0
1-10 M	47	37.6
10-25 M	28	22.4
25-50 M	18	14.4
> 50 M	12	9.60
Firm size		
< 49	31	24.8
50-99	28	22.4
100-249	39	31.2
> 250	27	21.6
Years since integration		
< 1	12	9.6
1-2	27	22.4
3-5	75	56.8
6-10	11	8.8
> 10	3	2.4
ERP system		
Microsoft	46	36.8
SAP	30	24.0
Oracle	13	10.4
Primavera	9	7.2
PHC	8	6.4
Sage	8	6.4
PeopleSoft	3	2.4
OutSystems	2	1.6
ArtSoft	2	1.6
Others	4	3.2
CRM system		
Microsoft	56	44.8
Salesforce	26	20.8
Custom made	11	8.8

(*continued*)

Table I.
Characteristics of the sample

Characteristics	*n*	%
NetSuite	7	5.6
Oracle	2	1.6
Sage	7	5.6
SAP	6	4.8
Primavera	3	2.4
Zoho	5	4.0
Others	2	1.6
IT infrastructure sophistication		
IT architecture and standards	111	88.8
Security and risk management policies	99	79.2
The latest back-end technology	87	69.6

Table I.

Notes: *n*, number of responses; %, the percentage of the 125 respondents

The ERP system variable is operationalised as the extent to which ERP is being used to conduct the firm's value-chain-based activities. It refers to the scope of ERP system modules a firm uses in daily business activities. The way we measure this variable is similar to that in earlier studies (Ranganathan and Brown, 2006). More precisely, this variable was measured through three item-questions that assess the extent to which a firm uses ERP financial module, supply chain module, and manufacturing module.

The CRM system variable is operationalised as the extent to which CRM is being used to conduct the firm's customer-oriented based activities. It refers to the scope of CRM system modules a firm uses in daily business activities. The way we measure this variable is similar to that in earlier studies (Payne and Frow, 2005). More precisely, this variable was measured through three item-questions that assess the extent to which firms use CRM marketing module, sales module, and service module.

The system integration variable is operationalised as the extent to which different information systems are interconnected and can communicate with one another. It refers to the extent to which information systems are technically integrated along the value-chain and customer-oriented based activities. The way we measure this variable is similar to that in earlier studies (Barki and Pinsonneault, 2005). More precisely, this variable was measured through three item-questions that assess the extent to which a firm's ERP system is integrated with the firm's CRM system and business partner's IS, and by the extent to which the firm's CRM is accessible by the firm's business partners via web or other electronic networks.

The process integration variable is operationalised as the extent to which operational information is shared between the firm's departments or locations. It refers to the extent to which decision-making processes are based on real-time information throughout the value-chain and customer-oriented based activities. The way we measure this variable is similar to that in earlier studies (Rai *et al.*, 2006). More precisely, this variable was measured through three item-questions that assess the extent to which a firm shares inventory levels and product information across departments or locations, and shares demand and forecasting information across departments or locations.

The business value variable is operationalised as a second-order construct manifested by three business value dimensions, as defined with regard to the arguments made above. The way we measure this variable is similar to that in earlier studies, whereby such a second-order approach represents a theoretically strong basis for capturing complex measures (Zhu and Kraemer, 2005). More precisely, this variable was measured through six item-questions grouped into three dimensions that assess the impact on internal

operations (decreased internal operations costs and improved on-time delivery), impact on procurement (decreased inventory and procurement costs), and impact on sales (improved sales, and customer service and support).

4.3 Control variables

Earlier studies suggest that ancillary factors can influence ERP and CRM business value. Firm size is used as a proxy for the resource base of the organisation that may influence the firm's integrative information systems value and business value (Elbashir *et al.*, 2013). Time since both systems were integrated was included to measure the knowledge and experience that organisations obtain from working over time (Elbashir *et al.*, 2013). IT-related infrastructure sophistication assesses the differences in both generic and specialised systems that may affect the integrative value and also performance (Elbashir *et al.*, 2013). Hence, we use three controls: firm size, time since integration, and IT infrastructure sophistication.

5. Results and analyses

In the next two sub-sections, we analyse the instrument validation (measurement model and the structural model). As none of the items in our data are normally distributed ($p < 0.01$ based on the K-S test), the partial least squares (PLS) is the appropriate method to use to estimate the research model (Chin, 1998; Henseler *et al.*, 2009). We used SmartPLS 2.0 (Ringle *et al.*, 2005) software to analyse the models.

5.1 Measurement model

In our model, we have reflective constructs. In the context of PLS the measurement model for the reflective constructs should be evaluated based on indicator reliability, construct reliability, convergent validity, and discriminant validity (Henseler *et al.*, 2009). First, the indicator reliability is the absolute standardised loadings. This indicator was evaluated based on the criteria that the loadings should be greater than 0.7 and that every loading less than 0.4 should be eliminated (Henseler *et al.*, 2009; Chin, 1998). The items are reported in Table II, where it is seen that the loadings are greater than 0.7, with the exception of two (CRM2 and ERP1), which are lower than 0.7 but greater than 0.4. Hence, no items in the table were eliminated.

Variable	Items	Loading	*t*-stat.*	AVE	CR
CRM system	CRM1	0.717	10.158	0.517	0.760
	CRM2	0.628	7.151		
	CRM3	0.800	12.444		
ERP system	ERP1	0.684	7.854	0.628	0.769
	ERP2	0.888	19.493		
System integration	SYI1	0.887	36.709	0.628	0.769
	SYI2	0.890	31.019		
	SYI3	0.717	10.754		
Process integration	PRI1	0.846	28.264	0.696	0.873
	PRI2	0.817	19.600		
	PRI3	0.839	18.013		
Business value (2nd-order construct)					
Impact on operations	IO1	0.870	44.526	0.764	0.866
	IO2	0.878	44.006		
Impact on procurement	IP1	0.889	47.255	0.752	0.858
	IP2	0.845	21.596		
Impact on sales	IS1	0.926	67.193	0.849	0.918
	IS2	0.917	52.539		

Table II. Item question loadings, CR, and AVE variables values

All the items are statistically significant at 0.001. Overall, the instrument presents good indicator reliability. Second, construct reliability was measured based on the composite reliability (CR) and values higher than 0.7 can be regarded as satisfactory. Table II shows that the CR for each variable is above the cut-off of 0.7 (Chin, 1998; Henseler *et al.*, 2009). Third, average variance extracted (AVE) was used as the criterion to test convergent validity. The AVE should be higher than 0.5, so that the latent variable explains more than half of the variance of its indicators (Henseler *et al.*, 2009; Fornell and Larcker, 1981; Hair *et al.*, 2012). Table II shows that the AVE for each variable is above the cut-off of 0.5 (Chin, 1998).

Fourth, discriminant validity is the extent to which a construct is truly distinct from other constructs by empirical standards. Thus, establishing discriminant validity implies that a construct is unique and captures phenomena not represented by other constructs in the model (Hair *et al.*, 2012). Discriminant validity of the variables was assessed using two criteria: the Fornell-Larcker (1981) criterion and cross-loadings. For the first criterion, we compute the square root of AVE (Table III in italics) for constructs that are greater than the correlation between each pair of constructs (off-diagonal elements), except with regard to the correlations involving the construct "business value", and the three constructs contributing to it (impact on operations, impact on procurement, and impact on sales). This was to be expected since "business value" corresponds to a second-order construct of "impact on operations", "impact on procurement", and "impact on sales". The second criterion ensures that the loadings of each indicator are greater than all (Chin, 1998). The table with loadings and cross-loadings is available from the authors on request.

Our model has good indicator reliability, construct reliability, convergent validity, and discriminant validity. Thus, variables developed using this measurement model can be used to assess the structural model.

5.2 Structural model and hypothesis testing

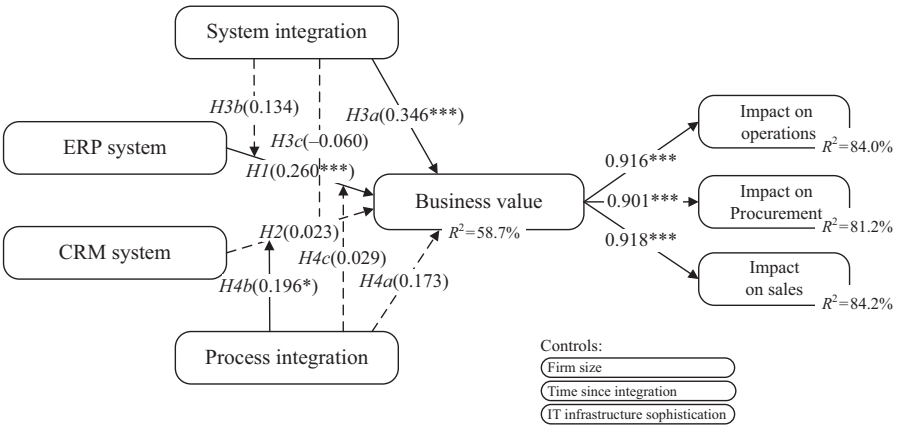
The structural model was assessed by examining the R^2 and the level of significance of the path coefficients. The research model explains 58.7 per cent of the business value variation, which is considered substantial (Chin, 1998). Therefore, we believe that the variables model significantly explains data variations for integrative value and its underlying business value dimensions. The significance of the path coefficients was derived from bootstrapping (5,000 resamples) (Chin, 1998). Figure 2 shows the model results and path coefficients.

Figure 2 shows that ERP systems have a positive and significant impact on business value (0.260***) and CRM system shows a positive impact but is not statistically significant (0.023). Therefore, only *H1* is supported. System integration has a positive and significant impact on business value (0.346***) and process integration shows a positive impact but is not statistically significant (0.173). Hence, only *H3a* is supported.

Variable	Mean	SD	CRM	ERP	SYI	PRI	VAL	IO	IP	IS
CRM system (CRM)	3.536	0.939	*0.719*							
ERP system (ERP)	3.664	1.107	0.659	*0.793*						
System integration (SYI)	3.299	1.191	0.590	0.573	*0.835*					
Process integration (PRI)	3.093	1.130	0.573	0.519	0.705	*0.834*				
Integrative value (VAL)	3.568	0.933	0.536	0.573	0.654	0.621	*0.809*			
Impact on operations (IO)	3.656	0.954	0.505	0.501	0.599	0.596	0.916	*0.874*		
Impact on procurement (IP)	3.577	0.926	0.490	0.563	0.603	0.533	0.901	0.749	*0.867*	
Impact on sales (IS)	3.452	1.219	0.472	0.506	0.588	0.569	0.918	0.764	0.729	*0.921*

Note: Diagonal elements are square root of AVEs and off-diagonal elements are correlations

Table III.
Descriptive statistics, correlations, and the square root of AVEs



Notes: To avoid a crowded graph, indicators for each construct are not shown in the graph. *$p<0.10$; **$p<0.05$; ***$p<0.01$

Figure 2.
Model results and path coefficients

The moderation effect of system integration on both ERP system and CRM system are not statistically significant, and hence *H3b* and *H3c* are not supported. Although the moderation effect of process integration shows a positive and significant effect on CRM system (0.196*), it is not statistically significant on ERP system (0.029). As a result, only *H4b* is supported.

In short, *H1* (ERP system), *H3a* (system integration), and *H4b* (the process integration moderator of the CRM systems on business value) are supported. *H2* (CRM system), *H3b* (the system integration moderator of the ERP system on business value), *H3c* (the system integration moderator of the CRM system on business value), *H4a* (process integration), and *H4c* (the process integration moderator of the CRM system on business value) are not supported.

6. Discussion

The empirical results demonstrate two major findings: ERP systems by themselves are still considered an important asset to business value, while CRM systems' impact on business value is shown to be not significant, even if positive; and system integration as moderator of ERP or CRM system is shown to be not significant but has a positive and significant impact on business value. For process integration, we conclude that it is significant only when moderating the CRM system variable.

Our results show that ERP systems, even if considered as standardised and a commodity in earlier literature (Hsu, 2013a), are still found to be valuable to companies and key contributors to business value. ERP systems support critical parts of firms' value chains, operations, procurement, and sales processes, and therefore have a great impact on business value. Earlier IT and ERP literature (Hsu, 2013b; May *et al.*, 2013) also indicates that the mere adoption of these kinds of systems does not guarantee business value gains, and at the same time RBV says that a resource is more likely to generate value when not widely used (Hsu, 2013a), which is the case of ERP systems (usage for several years and dependence on software vendors for configuration and functionalities). Nevertheless, we have concluded that ERP systems are critical and encompass core processes of companies to the point that, where correctly implemented, they may have specificities to each firm that are difficult to imitate and contribute to competitive advantage and business value.

On the other hand, CRM system shows positive but non-significant impact on business value. Enterprise software such as CRM systems, as delivered by software vendors, contain out-of-the-box functionalities that are widely used without the need for configuration or

customisation (Ruivo *et al.*, 2015). According to RBV, these can be seen as easy to imitate and therefore less important for competitive advantage or business value, which falls into line with our findings. The moderator effect of process integration shows that CRM systems can become more impactful on business value when well integrated with firms' business processes (Chang *et al.*, 2014). While in this study we could not conclude that CRM system is core in business value creation, CRM should always be seen as a business strategy that affects technology, but also people, and more importantly business processes.

System and processes integration are two firm-specific capabilities that, according to RVB, can affect business value (Hsu, 2013b) since technology can be easily imitated but not the knowledge and transformation needed to integrate systems and streamline business processes. Our results show that the system integration moderation effect in both ERP and CRM systems is not significant, but nevertheless proved to be significant to business value. One conclusion we can take from this result is that there might be other systems besides ERP and CRM contributing to business value, such as e-commerce systems, internal line of business applications, partner and supplier systems, etc.

Process integration, on the other hand, is not significantly affecting business value, but has a positive and significant contribution in the moderation of the CRM system variable. Therefore, and in line with literature (Liu *et al.*, 2013; Alshawi *et al.*, 2011), CRM is a business strategy that affects technology, people, and also business processes, and our results show that CRM system will in fact have a greater impact on business value when deeply integrated into firms' business processes.

6.1 Managerial implication

We make four fundamental managerial recommendations with this study: first, the results imply that firms can create business value by developing a joint software system consisting of ERP and CRM. More precisely, results show that firms with greater levels of system integration are generating higher business value. This implies that managers should define as a strategy the integration of disconnected systems such as CRM and ERP to achieve higher value. This points to the importance of moving beyond individual systems value creation. Second, our results showing the significant value implication of ERP on business value but not significant for CRM, imply that ERP systems *per se* create higher business value even when coupled with a CRM system. This implies that managers should first focus on making sure that the firm's ERP systems are well implemented and configured and then couple CRM and other systems. In doing this, the value of ERP is amplified (Hsu, 2013b; Pedron *et al.*, 2016). Third, our results show that when CRM and ERP are simply technically integrated, CRM does not create high business value. CRM creates greater business value when processes are integrated with ERP and other systems. This points to the importance of broader IT system integration when coupling systems. Instead of accumulating functional modules within a software system and having the systems technically integrated, both IT and functional managers need to take into consideration processes integration between systems. Managers should blur the lines between CRM and ERP systems by also pushing ERP information to the frontline CRM, shifting from unidirectional to bidirectional data-flow between systems. If firm's sales, service, and other frontline departments have fingertip access to select ERP information in their CRM system, they can immediately address customer questions about product availability or review the status of credit checks for new customers without wasting time e-mailing or chasing their finance team. Lastly, CRM vendors should pay attention to developing their applications to create higher value in accordance with business process integration, for example, social networks and sentiment analysis systems as part of CRM process integration. This may help increase the value of customer's CRM systems, the joint value of CRM and ERP, and the market value of vendor's products.

6.2 Contributions to theory

This study extends the literature in four ways: we include the integration of CRM and ERP applications in the analysis of value creation, we include system and processes integration to explain business value, we investigate how system and process integration moderates the ERP and CRM system to explain business value, and we examine the link between information system value and business value. There is earlier literature and theory around the value created by ERP and CRM systems but it is very limited when it comes to addressing the importance and benefits of using ERP and CRM systems integrated and as important contributors to business value. As our model was based on the RBV theory, we also addressed the moderating effect of system and process integration, since these are two very specific firm capabilities that may create competitive advantage and also contribute to business value.

6.3 Limitations and future work

One of the limitations of our research has to do with the sample size and variety. We targeted 400 firms in Portugal and Spain with the questionnaire and received 125 valid responses. Future work will be to assess the model's variables relationships with a larger sample by, for example, expanding it to other countries and comparing the results. With this study we have not made any industry-specific analysis, even though we analysed the industries of the respondents. The use of ERP and CRM systems and also their integration with systems and processes might differ from one industry to another, as, for example, in the modules of ERP and CRM typically used. Our results show that CRM system is still not seen as critical to business value. According to literature (Liu *et al.*, 2013), CRM systems are proved to be adopted by companies in markets in which products are more differentiated or in which entry costs are lower, and that at the same time it should be seen as a business strategy that affects not only technology but also people and processes (Liu *et al.*, 2013; Alshawi *et al.*, 2011; Chang *et al.*, 2014). This means that our sample and analysis might have been affected by the role of the person responding (we had ca. 25 per cent IT/IS managers), and/or the market, strategy, or type of business of the companies targeted. Future work might compare, for example, the results from IT-related roles with business roles.

7. Concluding remarks

Our work focussed on measuring the impact of ERP and CRM systems, as well as the moderating effect of system and process integration on business value. For that, we developed a research model based on RBV theory. To test the proposed model, data were collected by Microsoft. In total, 125 valid responses from the Iberian region (Portugal and Spain) were used to test the conceptual model. According to the results and their significance, we propose that companies continue to implement ERP systems in order to create business value but at the same time not neglect the importance that the integration between those ERP systems and the broader IT infrastructure might bring to their business value. Our results show that ERP systems still have a direct impact on business value by themselves, so they should be kept as a priority to companies. Moreover, firms should take into consideration the integration between business processes and CRM systems, as this will definitely impact the business value extracted from these systems. CRM systems need to be part of a broad set of business processes and not just another software package in which data are stored but without effect on business processes or decision making. We find our study to be unique in the way we approach the integration between ERP and CRM systems as drivers of business value, and also in the way we bring system and process integration to moderate the two IT resource variables. We also hope that this study and the model we developed and tested can contribute to further research in this area, for example, by extending it to other systems such as e-business and supply chain management systems.

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Appendix

Variable	Indicators	Literature support
Taking into consideration the integration of ERP with CRM please rate the following questions		
ERP system	Using a five-point scale, where 1 means "low" and 5 "high", please rate to the extent to which: ERP1 – your firm uses financial module ERP2 – your firm uses supply chain module ERP3 – your firm uses manufacturing module	Ranganathan and Brown (2006)
CRM system	Using a five-point scale, where 1 means "low" and 5 "high", please rate the extent to which: CRM1 – your firm uses sales module CRM2 – your firm uses marketing module CRM3 – your firm uses service module	Payne and Frow (2005)
System integration	Using a five-point scale, where 1 means "low" and 5 "high", please rate the extent to which: SYI1 – your ERP is integrated with your CRM system SYI2 – your ERP system is integrated with your business partner's IS SYI3 – your CRM is accessible by your business partner via web or other electronic networks	Barki and Pinsonneault (2005)
Process integration	Using a five-point scale, where 1 means "low" and 5 "high", please rate the extent to which: PRI1 – your firm shares inventory levels across departments or locations PRI2 – your firm shares product information across departments or locations PRI3 – your firm shares demand and forecasting information across departments or locations	Rai *et al.* (2006)
Business value (impact on firm performance)	Using a five-point scale, where 1 means "increased a lot" and 5 – "decreased a lot", please rate the extent to which the following have increased, decreased, or stayed the same in your firm as a result of using integration of ERP with CRM	Zhu and Kraemer (2005)
Impact on operations	IO1 – internal operations costs IO2 – on-time delivery	
Impact on procurement	IP1 – procurement costs IP2 – inventory costs	
Impact on sales	IS1 – sales IS2 – customer service and support	
	Please assess your firm's IT infrastructure sophistication (Y/N): ITAS – IT architecture and standards SRMP – Security and risk management policies LBET – The latest back-end technology	Elbashir *et al.* (2013)

Table AI.
Item measurements

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