

The relationship between ERP Capabilities, Use and Value

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Abstract

This study assesses the effect of some extended Enterprise Resource Planning (ERP) capabilities (Collaboration, Analytics, Web-portals, Add-ons) and ERP use on ERP value. The research conducted, followed a mixed-methods approach using an exploratory study (Delphi) and the resource-based view of the firm to understand the ERP capabilities and develop three competing models surrounding these capabilities, ERP use, and ERP value, and then a confirmatory study using a large-scale survey of firms in Germany, Portugal, and the United Kingdom, to test these models. Results suggest that the moderation model best explains the relationships, while the additive model highlights the direct effects of both ERP capabilities and ERP use on ERP value in an interesting way. Results highlight that the role of ERP use is more critical when moderating ERP capabilities and ERP value, as well as when additive to ERP capabilities, than when mediating between ERP capabilities and ERP value. The practical value of the study lies in the fact that this investigation provides new knowledge on how some extended ERP capabilities may positively influence value from investment, and together with ERP use, provide business value.

Keywords: ERP; use; value; models; capabilities.

1. INTRODUCTION

It is a well-acknowledged fact that organizations in recent decades have spent millions of dollars in implementing Enterprise Resource Planning (ERP) systems. Gartner [1] estimated a market size worth about 32.6 billion dollars in 2016. Market Research Future [2] presented a report in June 2018 that stated that the ERP industry generated a revenue of around 47 billion dollars and that the ERP market will continue to grow by 7% until 2022. However, despite this high spending, there is confusion as to the effect that ERP software has in creating value for an organization [3-5]. On the one hand, the studies by Mata et al. [6] and Al-Mashari and Al-Mudimigh, [7] claim that merely implementing an ERP provides hardly any value. Similarly, Shehab et al. [8] and Beard and Sumner [9] claim that a reduction of costs through ERP implementation may not directly add value in the long run. Further, Nwankpa [10] and Aburub [11] argue that the success of ERP only relies on its usage. On the other hand, some studies strongly assert that organizations that have implemented ERPs enjoy considerable benefits [12-16]. In fact, theories from both supply chain management and information systems affirm that ERP systems allow information to flow transparently in a firm's ecosystem, benefiting supply chain efficiency [10, 17-22]. Moreover, ERP vendors claim that ERP systems can bring operational excellence and competitive advantages to firms [23, 24]. Attracted to such benefits, large firms have implemented ERP systems extensively, and in recent years small and medium-sized enterprises have also followed suit [22, 25]. Even if there have been some attempts to measure ERP value in different ways, such as Shen et al. [5] who created and tested a performance measurement model building on the balanced scorecard approach, as well as Parthasarathy and Sharma [26] who explored the role of customization in getting value from an ERP implementation, there is still an intriguing question, among decision-makers in organizations, whether or not the use of these kinds of systems actually provide value to an organization.

How ERP is used in organizations has also changed over the last few years. New ways of delivering ERPs are on the rise, but the earlier predominating model of proprietary implementation remains the dominant model. However, proprietary implementation has a "competitor" in the software-as-a-service (SaaS) model [27] or as it is sometimes labeled, cloud-based ERP solutions [28]. Nonetheless, some authors have expostulated that ERP has to be used in a particular way in order to add value to an organization [29, 30]. It is also a fact that ERP vendors have developed more and more functionality in their ERP systems, resulting in the increased capability of ERPs, and companies have been more willing to adopt and buy these (often expensive) software capabilities with the expectation that doing so might lead to greater value [24, 31]. Although Uwizyemungu and Raymond [32] successfully asserted value received from an ERP system, they failed to identify which software capabilities impact business value.

Given that transferring ERP capabilities into business functionality in an ERP suite is the goal of software vendors, it can be claimed that these capabilities are developed into software capabilities such as collaboration, analytics, web portals, and add-ons. For instance, analytics has been in focus for ERP vendors for some years, as have web portals and add-ons. In 2007 SAP acquired BusinessObjects and has since then developed it as a front-end application that allows users to view, sort, and analyze data. Oracle Business Analytics is a similar solution that promises to enable organizations to gain value from ERP data. Web portals have also been in the spotlight among ERP vendors for some time. For example, Sage recently introduced its new Web UIs for Sage 300, while Microsoft Dynamics has, for some years, offered its products as a SaaS solution. Add-ons have also been in the limelight as a way of improving the ERP software. Microsoft Dynamics, with its different products,

has offered add-ons as a way of improving functionality for many years. All in all, it would be fascinating to explore if these increased capabilities (or features) actually have an impact on ERP value.

A recent ERP survey on CIOs by Accenture [33] reveals that firms that implemented ERP systems in the 1990s and early 2000s are extending the core ERP with capabilities that did not exist before to empower their organization to be future-aligned and core-nimble to chase new business value. In the same direction, Chofreh et al. [34] have already highlighted the imperatives for continuous, up-to-date research of ERP systems and proposed some directions. One avenue is to study the ERP life-cycle systems extension phase after the post-implementation. We believe that these extensions are capabilities that, when combined with system use, create business value. Moreover, system use inherently does not mean there is value from it.

Furthermore, for sustained use or continued use, it is crucial to not only have initial use but also ensure that stakeholders and organizations are deriving value from it [68, 69]. Thus, a study that examines how use, value, and the capabilities work together is essential. Our research aims to contribute to filling the gap in the literature highlighted by Chofreh et al. [34].

Drawing on the above discussion and given the mix-up surrounding the value added from ERP, the ERP capabilities, and ERP use, in this study, we explored these relationships in detail. The motivation for seeking to clarify this relationship is the unclarity that exists among what it is that actually creates value from an ERP investment. That is, literature and practitioners seem to be unclear whether it is the sole use of ERP, if it is a specific extended capability of ERP, or a combination of these features that enable firm value [12, 34-38]. Among these, only Ruivo et al. [121] attempt to bring some clarity to the conundrum but fall short in assessing the broader nature of the role of system usage in relation to extended capabilities on ERP value. From a practical point of view, it is of interest to crystallize this so that potential adopters know if they should invest in new additional capabilities or focus on the use of an already adopted ERP.

Motivated by these issues and drawing on the resource-based view (RBV) theory of the firm, this study seeks to contribute to IT value literature by answering the following research question: “What is the nature of the relationships between extended ERP capabilities, ERP use, and ERP value?”

The remainder of the work is as follows: next, we review the foundational literature surrounding our core constructs of interest, followed by a discussion of the Delphi study that led to the confirmation of the extended ERP capabilities that were included in the study. We then develop our three competing models and describe the methodology for empirically testing our models. We conclude with a discussion of our results and enunciate our contributions to research and practice.

2. LITERATURE REVIEW

2.1 ERP Value

Researchers such as Mabert et al. [39] and Cotteler and Bendoly [21] suggest that most improvements in ERP usage are in intangible areas such as increased interactions across the enterprise, quick response time for information, integration of business processes, and availability and quality of information [40, 41]. Similarly, Gattiker and Goodhue [42], Park et al. [43], and Rhodes et al. [44] report that there are also improvements in communications, customer satisfaction, and management control when adopting an ERP. Galy and Saucedo [45] provide support for a cause-and-effect relationship of managerial actions to financial performance in a post-ERP implementation stage. Studies conducted by Hitt et al. [46] and Nicolau and Bhattacharya [47] found

that ERP improves coordination between different units, the efficiency of business processes, and user productivity. Nwankpa [48] claims that ERP-enabled application integration influences overall ERP benefits. This finding is in line with the study by Hsu et al. [49], who found that service quality interacts with information quality and system quality, promoting ERP system's post-implementation success by increasing employees' extended use.

Jacobs and Bendoly [50] and Santhanam and Hartono [51] suggest that ERP should be viewed as a capability because performance improvements such as those mentioned above can be achieved all at once. [As presented in the introduction](#), the study by Uwizeyemungu and Raymond [32] claimed that [firm performance is due to system capability](#), and this can be in different forms, one of them being ERP integration. While these studies all successfully assert the value received from an ERP implementation, they [do not identify nor measure](#) which components ([extended capabilities](#)) of the software package specifically affect value in organizations. Our review also highlights that few studies examine how ERPs contribute to organizational value when firms are actually using the system [42, 46, 52]. As Melville et al. [53] suggest, most of the research on IT value focuses on IT as a resource itself, but not on the much richer area of IT capabilities. Thus, this present study looks at the firm's ERP use and some extended ERP capabilities (in the form of software/business capabilities), and how these capabilities may add value to the organization.

2.2 RBV and ERP value

Given that we view ERP as a resource, we used the Resource-Based View of the firm (RBV) as a theoretical lens to understand the extent to which different ERP capabilities contribute to firm value. In reviewing earlier research focused on the antecedents or conditions under which the value of an ERP system contributes to firm performance [54-57], we found few studies that have examined ERP from the resource-based perspective [24, 32, 35, 36, 44, 58]. Lengnick-Hall et al. [59] conclude that ERP is useful in leveraging the firm's other resources and that the value of ERP is attained mainly through capabilities that the system provides. Laframboise and Reyes [60] found that the influence of ERP systems on firm's performance is only indirect, that is, through integration with other capabilities. Sedera et al. [61] investigated the role Enterprise Systems (ES) has on innovation and found that the context in which the system is used in has a great deal of impact, thereby suggesting the role of contingent factors. Stratman [62] found that through its portfolio of competencies and available resources, a firm's strategic focus influences the ERP utilization, and eventually the benefits realized from ERP. Shao et al. [63] found that leadership styles are related to the level of ERP assimilation and that organizational learning is a mediating construct between top management leadership styles and levels of ERP assimilation. From that, it could be expected an increase in adoption level. The ERP system adoption is thus seen to reflect, to some extent, the strategic vision of the firm's management team to increase performance [64, 65]. This aspect could also be related to the study by Krell et al. [66], who found that both the project management approach and team competence influence IS adoption success.

According to Barney [67], studies investigating the relationship between IT resources and firm performance conclude that tangible IT resources (IT infrastructure) represent the fragile source of IT value because competitors can copy the resources. Drawing on the RBV, it may also be argued that IT value can result in a significant part from the development of intangible capabilities when embedded in a firm's daily business, that is, only when ERP is actually used [68, 69]. In this way, our study focuses in particular on the relationship

established between some extended ERP capabilities and ERP use and how these explain ERP value. Our specific interest is to investigate if the specific ERP capabilities; Collaboration, Analytics, Web-portals, Add-ons, lead to value.

Earlier studies based on the RBV have generally sought to identify a direct causal link between IT resources and IT value [51, 60, 70], thus favoring the use of causal models. In this study, we link ERP capabilities to ERP value. That is, ERP capabilities provide value to the firm, improving its performance. Santhanam and Hartono [51] have claimed that it is critical to developing theoretically derived multidimensional measures of IT capability in order to continue to apply the RBV approach to assess the impact of IT value. Some of the earlier studies used the assessment of IT-managers' firms as a proxy for IT capability [51, 71]. Another example of a study of senior executives' understanding of business performance gained from ERPs is the study by Chang and Seow [72]. The conclusion they could draw was that the ESs adoption influences business performance and that assimilation mediates the effect of the adoption on business performance.

Regarding the role of ERP use on ERP value, it can be stated that despite its theoretical importance, use has been understudied in empirical research, as pointed out by Zhu and Kraemer [73], Ifinedo et al. [74], and by Nwankpa, [10]. RBV and the classic model for general IS success developed by DeLone and McLean [75] suggest that there tends to be a strong link between system use and system impact. This foundation then motivates analyzing the linkage from usage to impact. In order to generate information relevant to conducting business activities such as sales, customer services, or procurement, ERP system capabilities first need to be exploited. For example, any ERP supports hundreds of standard reports for historical and summary data, but ERP users first need to use the system routinely in order to generate value [73, 76, 77]. From that standpoint, the usage of ERP is of importance. While the quality of ERP system use results in better information and the quality of ERP information, use, in turn, results in enhancing the impact of available information in meeting organizational objectives [29, 57, 74]. The availability of information by itself is no guarantee that it is being used effectively by all users. The value from ERP systems arises from effectively using the data and information capabilities of the system to empower all users in their daily tasks and their innovativeness, rather than relying on its mere technical capabilities [17].

Hedman and Kalling [78] used RBV and extended Mata et al.'s [6] framework for organizational and business resources, with the conclusion that ERP systems are IT resources that have intangible capabilities that can lead to IT value. From the RBV perspective, some researchers have shown that enhancements to firms' business processes through collaboration [19, 42, 55, 79-81] and analytics [68, 80, 82-86] together with system routinization (use) [73, 76, 77] are additional important dimensions that will influence IT resources' value. Swaminathan and Tayur [87], Rai et al. [19], and Ruivo et al. [25] argued that the full potential of an ERP system could not be realized if its collaboration and analytics capabilities are not exploited. Both extend the original value proposition of ERP, offering the opportunity to firms to build interactive relationships with their business partners and bring empowerment to every user. With ERP systems, firms can form a set of specific capabilities that guide both internal and external collaboration and comprise the means to learn and perform business analyses [17, 71, 88].

Several researchers support 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 and amplifying the ERP value. Furthermore, although ERP systems are essentially transaction-

focused, those firms that use ERP analytics capabilities can easily and quickly learn how to use data for managerial decision making and realize an advantage in their pursuit of sustainable performance through unique business insight information [20, 42, 50, 82, 84, 88-91]. This premise is in line with what Krishnamoorthi and Mathew [92] state when claiming that IT, as a general organizational capability, acts as a key mediator in business value creation.

2.3. ERP capabilities, use, and value

Collaboration is defined as the extent to which ERP supports firms' collaboration through value chain activities. It is measured by the degree of collaborating with colleagues for operational excellence and better service, collaborating with a firm's information management system and resource coordination, and timely communication with suppliers, partners, and customers to reduce waste in procurement and improve the firm's order fulfillment processes. In this way, collaboration defines the capability of an ERP system to seek support from and offer it to others to fulfil capacity needs that cannot be met by each one alone, increasing a firm user's effectiveness, including the way that people and system operate, work, and communicate [31, 99]. Although rooted in greater system integration [57, 100, 101], the collaboration capability may be viewed as the way to implement tactical or strategic initiatives [102], which is consistent with RBV – a firm's ERP can create unique capabilities that allow trading amongst employees as well as with partners and customers, all of which increases firm performance [17, 19, 38, 42, 79-81, 84].

Analytics is defined as the extent to which ERP provides analytical information for real-time fact-based decision-making. It is measured by the degree of comprehensive reporting generated through OLAP (OnLine Analytical Processing) or data mining, real-time access to information from querying or filtering the system, and data visibility across departments such as through scorecards, dashboards, or notifications. Although rooted in greater information and system quality [40, 74, 103, 104], analytics capability is the way to provide access to information along with the analysis and presentation of information, which might depend on third party software [105, 106]. As RBV suggests, firms that explore ERP analytical capabilities to manage their value chain activities boost their performance, making it more difficult for competitors to understand and imitate them [38, 68, 80, 82, 83, 85, 107].

Web Portals refers to the extent to which Web front-end functionality supports ERP value. Front-end functionality [73] is measured through the extent to which an ERP supports the organization's product catalog, its account management, and consumer customization. Web portals provide organizations with leverage from the Internet's characteristics from the usage of front-end functionality of an ERP system. From the RBV perspective, the competitive advantage benefit of front-end functionality may only be temporary since it is or could be easy for a competitor to replicate. However, despite that, it is suggested that web portals in the form of front-end functionality provide organizations using ERP systems with ERP value.

Add-ons is are defined as the extent to which vertical functionality provides an organization using an ERP system with improved ERP value. Nicolaou and Bhattacharya [47] studied add-ons in the form of enhancements.

Accordingly, Aslan et al. [108] and Olsen and Sætre [109] hold that to increase a firm's ability to comply with changing internal and external factors firms must be able to modify the standard software and to extend functionality whenever needed (such as for product configurator and production life cycle management). This

refinement is not easy to achieve with a standard OLTP (OnLine Transaction Processing) system, such as ERP. Instead of modifying the kernel part of an ERP system through internal/proprietary developments (the process is at least time-consuming, high code maintenance, and generally unacceptable), add-ons are a possible solution. These are often done in the current customer version, which confers unique characteristics that are aligned with the RBV. Add-ons are third party development made within the ERP system kernel by certified vendors. Contrarily to the line of business modules (SCM, CRM, HR), add-ons are generally industry solutions. Such examples can be add-ons to ERP for Utilities, Public Sector, and Healthcare [110].

In our study, we focus on whether add-ons influence ERP value. Add-ons can be seen as allowing increased functionality in the ERP system and extending the coverage of business processes managed by ERP systems. Since add-ons extend the core functionality of the ERP system, their proposed effect is in line with the proponents of RBV.

In addition to the above capabilities, our study also seeks to understand the importance of these constructs on ERP value, along with ERP use. Below, we provide a discussion of our adopted definition of ERP value and ERP use.

ERP value is defined as the extent to which business goals and business performance are improved by the ERP system adopted. It is measured by the second-order construct of the impact on internal operations and the impact on downstream sales, inspired by the research done by Zhu and Kraemer [73] on e-business value. Zhang et al. [111] and Bradford and Florin [112] concluded from their studies that value could be measured by user satisfaction and user productivity. Delone and McLean [75] conclude that greater employee productivity leads to higher system value, which is tied to organizational improvements. Nicolaou and Bhattacharya, [47], Park et al. [43], and Rothenberger et al. [30] define ERP value as customer satisfaction and management control. Some researchers report that improvements in customer satisfaction and management control really begin with user productivity [6, 20, 21, 42, 46, 88]. Consequently, we believe that the first-order construct of “impact on downstream sales” can be measured through the degree to which ERP widen the sales area and improve customer service.

ERP use is defined as the extent to which ERP is being used to conduct the firm’s value chain activities (sales, service, and procurement). This dimension is rooted in the degree of using the system in sales, service, and procurement [73]. As a result, it is only when firms are actually using ERP systems to conduct business that the system can have an impact on firm performance and be worthwhile [10, 47, 73, 75, 76, 113, 114].

3. RESEARCH MODEL AND HYPOTHESES - EXPLORATORY STUDY

3.1. Ranking the extended ERP capabilities

Most strategy researchers see the key aspect of capabilities as the managerial skills and competencies required to exploit assets. We used a Delphi method to identify and rank the extended ERP capabilities that were investigated [93].

The design and implementation of the Delphi study followed the structure and the explanations from Okoli and Pawlowski [94]. A web questionnaire was designed in which experts were asked to rank capabilities that create the ERP business value. Of the 40 invitations, 25 candidates agreed to participate in the Delphi study, which is

considered ideal according to Linstone and Turoff [95]. The panel was composed of experts from six countries: Denmark, Germany, Portugal, Spain, the United Kingdom, and the United States, all of whom are highly qualified in ERP software, with 87% having more than ten years of experience in the area. (the detailed profile of the survey respondents are available from the authors on request).

A descriptive explanation of each issue was provided. The description of each factor is reflected in the item description and questions in Appendix A. We also included an informative webpage in the questionnaire where experts could read the glossary surrounding the main concepts. The glossary content was built up on the same capabilities' description presented in the previous section.

During the study, five panel experts dropped out, leaving a panel of 20 experts who participated in the two rounds of the study. The two rounds were performed during 19 and 16 days, respectively, with an interval of 22 days between rounds for data analysis and to prepare the next round. With a homogeneous panel of 20 participants that completed the study, we believe that the results are relevant and are not constrained by the number of participants [94, 96].

The Delphi study followed the three steps suggested by Schmidt [97]: 1) Brainstorming of key issues and capabilities – we identified a list of 12 key issues from practitioners, journals, and own experience. The issues are shown in Table 1 and later on became the core factors as part of our initial test, 2) Narrowing of factors - we decided to exclude the narrowing phase based on our research goals and the number of items [97]. 3) Ranking - in the first round, the list of 12 factors was sent to the panel in random order to avoid any bias. For the second round, the skills were ordered by mean rank. The panel was asked to indicate their views by rating each factor for relevance. The panel was asked to indicate their views by rating each factor for relevance in which experts were asked to rate those factors on a 5-point numerical scale (1=Strongly Disagree and 5=Strongly Agree). The Delphi questionnaires and the task instructions were pre-tested with a sample of respondents comprising academics and practitioners who were not on the expert panel but possessed similar characteristics to enhance the reliability of the study and to avoid ambiguity. At the end of each round, Kendall's coefficient of concordance (W) was calculated to assess the degree of consensus among the panelists [94, 96, 97]. Until we achieved a reasonable degree of consensus, another round was conducted. The average values of the variables (being higher than 3) confirmed that we had identified a plausible set of factors. Experts responding to the second round were sent feedback showing the results of the first round so that individual judgments were modified or refined. The feedback included the mean ranks of items, Kendall's W coefficient achieved, and the expert's prior responses. As suggested by Delphi researchers [94, 96, 97], new factors are only included if they were suggested independently by at least three respondents. Since this criterion was not achieved, the suggested factors were not included. The aggregate ranking was used to reorder the list of factors. Factors were presented in order of importance as determined by mean rank. The results and analysis are presented next.

In terms of the analysis of the Delphi method, we used a set of measures of tendency, dispersion, association, and non-parametric statistics as proposed by several Delphi researchers [94, 96, 97]. We also performed a consensus measurement through a comprehensive and acceptable range of measures, to assure not only the group consensus but also the stability of the answers.

Table 1 shows the evolution of the factors during the Delphi study sorted by their position in the final round. This position was obtained using the average rank of each factor. For each round, we present the number of

respondents (N), Kendall's coefficient of concordance (W), and Spearman's rank-order correlation coefficient (Spearman's rho). The average rank (AVG), standard deviation (SD), and Rank position are shown for the 12 factors. The Delphi study was terminated in the second round with a total of 20 respondents, 75% of the initial group, a $W > 0.50$, and a Spearman's $\rho = 0.898$.

Table 1. Results of the ranking-type Delphi of the two rounds

ERP capabilities	Round 1			Round 2		
	AVG	SD	Rank	AVG	SD	Rank
<i>Collaboration</i>	4.23	1.11	2	4.82	0.87	1
<i>Analytics</i>	3.90	0.88	3	4.43	0.73	2
<i>Web-portals</i>	3.87	1.01	4	4.31	0.74	3
<i>Add-ons</i>	4.27	0.63	1	4.30	0.72	4
<i>Efficiency</i>	3.83	1.00	5	3.56	0.83	5
<i>Best-practices</i>	3.77	1.07	8	3.48	0.78	6
<i>Simplicity</i>	3.63	1.03	12	3.39	1.12	7
<i>Compatibility</i>	3.80	1.00	6	3.35	0.86	8
<i>Relative advantage</i>	3.67	1.09	11	3.28	0.84	9
<i>Competitive pressure</i>	3.73	1.10	9	3.25	0.79	10
<i>Regulatory support</i>	3.70	1.26	10	3.21	0.96	11
<i>Technology competence</i>	3.79	1.12	7	3.19	0.85	12
<i>Respondents number (N)</i>	25			20		
<i>Kendall (W)</i>	0.390			0.567		
<i>Spearman's Rho</i>	-			0.898		

In the first round, 25 experts completed the survey. The most critical factors ranked were Collaboration, Analytics, Web-portals, and Add-ons (AVG rank > 4). The highest standard deviation reached was 1.26 in the Regulatory support' factor, which indicates a lack of consensus among experts. In general, the factors presented high standard deviations, which explain the Kendall's W of 0.390, indicating a poor degree of consensus [97]. Hence, we conducted a second round (Table 1) to improve the level of concordance among experts. A total of 20 usable answers were received. In terms of concordance, Kendall's W increased to 0.567, which represents an acceptable degree of consensus. The Collaboration factor emerged as the #1 ranked, followed by Analytics. By analyzing the average ranking differences between both rounds, we were able to conclude that there was a degree of stability between rounds. We calculated measures of dispersion for the rank scores. To determine whether any ERP feature factors were particularly controversial, we examined the standard deviations to provide a more precise way to measure rank score consensus. The standard deviation of the rank scores represents the average of the differences between experts' scores and the group's average score. Standard deviations should decrease between rounds. Standard deviations should be zero to achieve a perfect consensus. Table 1 shows how the standard deviations changed over the ranking rounds. Overall the majority of factors reduced their dispersion across the rounds. As shown in Table 1, standard deviations were between 0.63 and 1.26. The major dispersion is observed in the last factors ranked by experts. We believe that this dispersion is due to the sample. The last factors are operational factors with which our experts were not so familiar. Overall, this dispersion analysis suggests that the ranking of factors is not controversial and that the level of consensus achieved is usual.

We applied association measures to finalize the consensus measurement, [98]. We chose to use Spearman's rank-order correlation coefficient (Spearman's rho), in order to measure whether consensus was being achieved, or otherwise, between rounds. A coefficient of 0.898 was obtained, meaning we achieved a high degree of consensus. Table 3 shows that mean rankings and standard deviations are relatively stable, as the rank position did not change significantly between rounds. Therefore, we believe that these small differences do not affect the results of the study, and we decided to complete the study at this point.

Since we intended to validate, reduce, and rank these 12 ERP factors, the Delphi study shows that Collaboration, Analytics, Web-portals, and Add-ons are the most important ERP capabilities. Hence, we retained these four ERP factors as the most important capabilities provided by the ERP system.

3.2. Building the Research Models

Based on the RBV framework and combining the four main extended capabilities of ERP identified by the Delphi study, we constructed the antecedents of the proposed models that explain ERP value. Whereas Collaboration, Analytics, Web-portals, and Add-ons refer to a firm's ERP capabilities, ERP use refers to the level of behavior that becomes routinized amongst the firm's employees.

Hypotheses of the three competing models

Drawing on the RBV theory, we developed three conceptual models to assess the value of ERP by firms. Following the past literature and the panel of experts we postulate that four extended ERP capabilities (collaboration, analytics, web-portals, and add-ons) and ERP use will have a positive effect on ERP value. Moreover, the propensity to these extended capabilities creating value are influenced by a key determinant that is ERP use. Therefore, we expect that by studying these capabilities considering the role of ERP use, there will be systematic differences between ERP value creation. Following Sarker et al. [115], we captured and labeled these as the "additive," "moderation," and "mediation" model. Below we present the three competing models surrounding the relationships between extended ERP capabilities, ERP use, and ERP value and one related hypothesis to each one of the research models. It is worth noting that each of these three models, hypothesized is built up on the literature review and Delphi study sections. In our opinion, a fundamental step to furthering knowledge in this area is to test these models with collected data empirically and from that to conclude which model(s) best explain(s) ERP value, as well as to what extent the extended ERP capabilities add value.

We refer to our first model as the additive model, in which we see the effect of both ERP use and extended ERP capabilities additively affecting ERP value (Figure 1). Researchers such as Hitt et al. [46] and Uwizeyemungu and Raymond [32] argue that the greater the number of ERP modules and capabilities offered, the greater the value from the ERP implementation. The majority of research points that extended Collaboration and Analytics capabilities have a direct effect ERP value [17, 19, 38, 42, 68, 79-85, 107]. Simultaneously, IS literature argues that when ERP is extended with Web-portals and Add-ons capabilities, firms tend to improve Sales and Operations improvement, been a crucial additive driver of ERP value [10, 47, 52, 73, 109, 110, 116]. On the other hand, others argue that the greater the extent of ERP use, the greater the likelihood that firms find value from their ERP systems [10, 52, 116]. Still, others claim that capabilities offered by ERP modules and adoption/use of ERP contribute to ERP value [20, 114]. From this, the following hypothesis is suggested:

H1: ERP Use and extended ERP capabilities (collaboration, analytics, web portals, and add-ons) will have

an additive effect on ERP value.

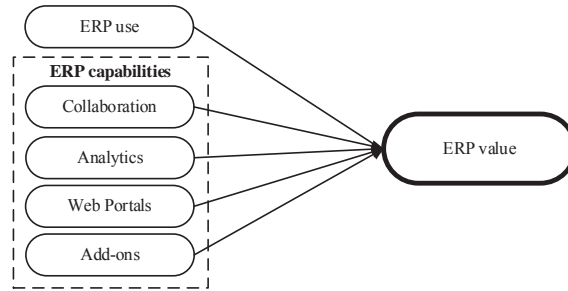


Figure 1. Additive model of the effect of ERP use and ERP capabilities on ERP value

The second model (Figure 2) is a mediation model. In contrast to the additive model and the moderating model, the mediation model argues that for extended system capabilities, system use mediates the effect on value. In other words, the conceptual linkages (i.e., system capabilities → system use, system use → system value) have been supported in the literature by, for instance, Zhu and Kraemer [73] and Devaraj and Kohli [117]. For example, past research has often argued that ERP capabilities do not directly affect ERP value, but that other variables play a mediating role [118]. For example, Ifinedo et al. [74] argued that a working group helped play a mediating role in realizing the positive impacts of ERP. The study by Bernroider et al. [119] argues that the nature of the implementation project influenced the relationship between dynamic ERP capabilities and business improvements by ERPs. Hsu [35] claims that ERP capabilities only create value when mediated by organizational resources such as user skills in operating the ERP. May et al. [12] conclude that the maximization of business process effectiveness depends on the maximization of ERP use as the mediating factor between system capabilities and value.

Similarly, Xu et al. [120] and Ruivo et al. [121] examined the role of ERP use as a mediator between technology, organization, and environmental aspects surrounding an ERP and ERP value. Drawing on this work, we argue that ERP use will mediate the relationship between ERP capabilities and ERP value. From this, the following hypothesis is suggested:

H2: ERP Use mediates extended ERP capabilities on the ERP value

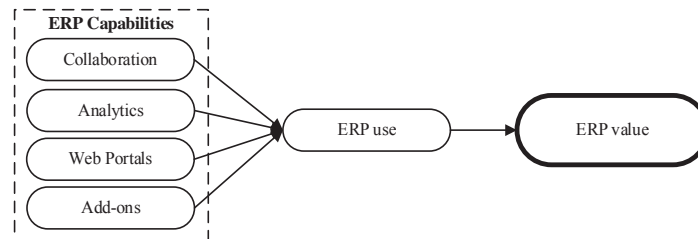


Figure 2. Mediation model of ERP use between ERP capabilities and ERP value

The third model (Figure 3) is a moderating model. While a dominant body of literature suggests that system use has a direct or mediating effect on performance (additively or with extended system capabilities), another competing perspective is that use is beneficial because it “facilitates” the effect of other variables on system value such as claimed by Nwankpa [10], Tsai et al. [56] and Gattiker and Goodhue [42]. Hong and Kim [122]

introduced the importance of fit and moderation in the context of ERP value and argued that successful ERP implementation depends on how well the ERP fits the organization. They specifically highlight that the value from ERP is received from not only how well the capabilities of the ERP fit the organizational requirements, but that this effect is contingent on the extent of ERP adaptation and use. Ram et al. [58] and Hwang and Grant [55] research concluded that system-specific capabilities to create value depends on the facilitation of ERP use. In the same line, HassabElnaby et al. [71] and Hong and Kim [122] claim that successful ERP implementation towards value realization can only happen when the organizational fit is achieved through ERP capabilities, and these be moderated by variables such as ERP use. In the context of general information technology, Melville et al. [53] suggest that IT capabilities affect business performance owing to the contingent effect of how well it is used in the business processes. Based on the above, in our study, we argue that the effect of ERP capabilities on ERP value will be moderated by ERP use. From this the following hypothesis is suggested:

H3: ERP Use moderates extended ERP capabilities on the ERP value

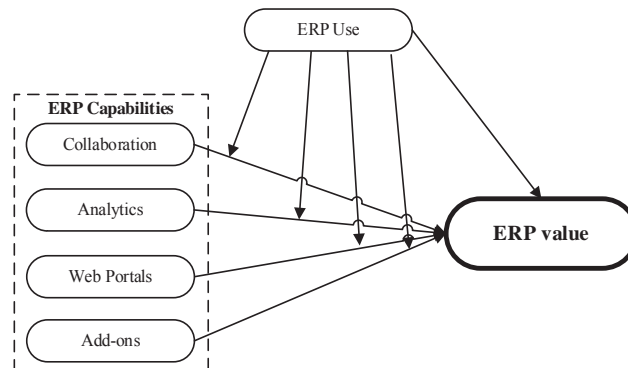


Figure 3. Moderating model of ERP use between ERP capabilities and ERP value

4. DATA COLLECTION - CONFIRMATORY STUDY

The confirmatory phase began by a web-based survey developed with appropriate items based on a literature review and Delphi study. The instrument (each item of the questionnaire, scope, and purpose) was reviewed for content validity [76] by a group of four established academic researchers and two language experts (German and English). Minimal adjustments were made to anchors and item questions, so the overall concepts best match the ERP domain. The initial questionnaire was pilot tested in 10 firms to test the readability of the questionnaire and assess any item's difficulty or ambiguity. As a result of this testing, the collaboration item question was reworded for Germany. The pilot test provided preliminary evidence of the reliability and validity of the instrument. The questionnaire was sent out with assistance from the International Data Capture Corporation (IDC) to a total of 2000 firms that have utilize ERP in their daily activities for more than 10 years, and 547 valid responses (responded by a single representative from each firm) were returned, resulting in a response rate of 27.4%, which when compared to other studies of a similar scale is high. The sampling was stratified by distinct cultural countries [123] (Germany, Portugal, and United Kingdom), by ERP vendor

(Microsoft Dynamics, SAP, Oracle, Infor, and Sage), by industry type (manufacturing, distribution, professional services, and retail), and by firm size to ensure the generalization of the survey results. In Table 2 we show the characteristics of the sample. Almost half of the firms are from Germany (47.9%). The vast majority of firms are small and medium-sized enterprises, they reported an Annual Turnover below 50M euros (79.7%) and having less than 100 employees (67.8%). In regards to ERP solutions in place in these firms, Microsoft Dynamics, SAP, and Oracle account to 72.8%. Data also show that Industry type is fairly distributed across Manufacturing, Distribution, Prof. Services, and Retail, and almost 81% of respondents were business or line of business owners. This factor also indicates that the respondents were individuals qualified to answer the questionnaire on their firm's ERP value, suggesting the good quality of the data.

Table 2. Characteristics of the sample

Characteristics		(N=547)	(%)	Characteristics		(N=547)	(%)
Country	Germany	262	47.9%	Respondent position	CxO	101	18.5%
	Portugal	106	19.4%		IT/IS manager	104	19.0%
	United Kingdom	179	32.7%		Finance manager	113	20.7%
Industry type	Manufacturing	158	28.9%		Sales manager	110	20.1%
	Distribution	148	27.1%		Retail manager	46	8.4%
	Prof. Services	118	21.6%		Manufacturing	73	13.3%
	Retail	123	22.5%	ERP vendor	DYNAMICS	164	30.0%
Annual Turnover (€)	<50M	436	79.7%		INFOR	68	12.4%
	>50M	111	20.3%		ORACLE	112	20.5%
Number of employees	<100	371	67.8%		SAGE	81	14.8%
	>100	176	32.2%	SAP	122	22.3%	

Non-response bias was analyzed by sample distributions of the early (446 firms) and late (101 firms) respondents [124, 125]. The Kolmogorov-Smirnov (K-S) test [126] was used to compare the sample distribution of the two groups (early and late respondents). The comparison showed that sample distributions of the two groups did not differ statistically at the 5% significance level ($p > 0.05$), suggesting the absence of non-response bias [126]. Furthermore, we also examined the common method variance (CMV) by using Harman's one-factor (or single-factor) test [127]. An exploratory factor analysis on the data for all items was conducted, as the results suggest a presence of more than one factor and the first factor explains only 26.67%. From the results, it can be claimed that no significant CMV exist in the data.

Constructs and measurement items were developed based on the theoretical foundation discussed in the previous section, as shown in Appendix A. The constructs were measured using statement items, and these statement items were scaled using a five-point Likert scale, in which 1 means "low" and 5 "high," in which respondents were asked to rate their individual perception on each item question.

4.1. Measurements

A sequential research design, as suggested by Venkatesh et al. [128], was used so that a literature review and an exploratory study (Delphi) fed subsequent confirmatory study (competing models).

The measures of this confirmatory study follow the same approach as Picoto et al. [129] and Côte-Real et al. [130]. Constructs and measurement items were developed based on the theoretical foundation discussed in the previous sections and on existing instruments adapted to fit the ERP context, as shown in Appendix A. For ERP use, ERP value, Collaboration, and Analytics constructs, we adapted items from prior literature. The Web-

portals and Add-ons constructs resulted from the literature review were validated by the experts' panel. In the Delphi study, we validate these two constructs definitions and measures in conjunction with Collaboration and Analytics. Hence, we kept the same statement items [130]. Complementary, we also considered the development of the instrument is the nature (either reflective or formative) of each construct. Since for Collaboration, Analytics Web-portals, Add-ons, and ERP use, we aimed to use measures to examine the underlying latent variable, and it is the latent variable that causes the measures, we used reflective constructs. For ERP value the indicators determine the underlying construct; they are formative Picoto et al. [129]. We classified the nature of each construct as presented in Appendix A.

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5. RESULTS

5.1 Measurement model

The results of the measurement model are shown in Tables 3 and 4. Construct reliability, indicator reliability, convergent validity, and discriminant validity were all assessed. Construct reliability was tested using the composite reliability coefficient. PLS prioritizes indicators according to their individual reliability. As shown in Table 3, all constructs have composite reliability above 0.7, suggesting that constructs are reliable [134].

Table 3. Descriptive statistics, CR, correlations, and the square root of AVEs

	Mean	SD	CR	ERPU	Col	An	WP	AO	IIO	IDS	ERP Value
ERPU	75.642	11.571	0.880	0.887							
Col	3.790	0.563	0.887	0.117	0.851						
An	4.040	0.542	0.872	0.262	0.497	0.834					
WP	2.308	1.069	0.923	0.077	0.000	-0.039	0.895				
AO	2.749	0.868	0.870	0.221	-0.003	-0.008	0.251	0.833			
IIO	3.733	0.499	0.902	0.298	0.596	0.499	0.079	0.113	0.906		
IDS	3.680	0.571	0.852	0.178	0.474	0.380	0.067	0.103	0.576	0.862	
ERP Value	3.723	0.470	0.862	0.274	0.608	0.501	0.083	0.122	0.908	0.865	0.783

Note: Square root of AVE (in bold on diagonal); ERP Use (ERPU); Collaboration (Col); Analytics (An); Web-portals (WP); Add-ons (AO); Impact on internal operations (IIO); Impact on downstream sales (IDS); ERP Value.

Indicator reliability was evaluated based on the criterion that every loading less than 0.7 should be eliminated [135, 136]. Accordingly, ERPU1 was eliminated. However, for the indicators with loadings between 0.4 and 0.7, such as the case of AO3, we examined if its elimination from the model goes along with a substitution increase of composite reliability or AVE about the suggested threshold value [136]; however, both cases were

not verifiable. Therefore, only one item from the questionnaire (ERPU1) was excluded after the PLS model estimation due to low loading. Hence, we consider the items in Table 4 (in bold), statistically significant at 0.001. Overall, the instrument presented good indicator reliability.

Table 4. Loadings and Cross-loadings

Construct	Item	ERPU	Col	An	WP	AO	IIO	IDS	ERP Value
ERP Use (ERPU)	ERPU2	0.900	0.127	0.238	0.096	0.195	0.257	0.192	0.256
	ERPU2	0.873	0.077	0.227	0.037	0.198	0.272	0.120	0.228
Collaboration (Col)	Col1	0.112	0.898	0.429	-0.012	0.003	0.554	0.503	0.598
	Col2	0.148	0.859	0.431	0.026	0.030	0.580	0.365	0.542
	Col3	0.011	0.792	0.413	-0.020	-0.059	0.340	0.312	0.369
Analytics (An)	An1	0.247	0.447	0.838	0.005	0.008	0.525	0.329	0.491
	An2	0.219	0.348	0.877	-0.039	-0.022	0.304	0.253	0.316
	An3	0.181	0.420	0.784	-0.073	-0.013	0.365	0.348	0.402
Web-portals (WP)	Wp1	0.109	0.014	-0.016	0.890	0.303	0.085	0.074	0.090
	Wp2	0.050	0.001	-0.065	0.920	0.167	0.066	0.044	0.063
	Wp3	0.028	-0.024	-0.032	0.874	0.167	0.054	0.054	0.061
Add-ons (AO)	AO1	0.167	0.005	-0.032	0.268	0.882	0.113	0.081	0.111
	AO2	0.173	0.014	-0.026	0.206	0.914	0.100	0.101	0.113
	AO3	0.236	-0.038	0.059	0.139	0.685	0.063	0.074	0.076
Impact on internal operations (IIO);	IIO1	0.257	0.490	0.367	0.108	0.152	0.897	0.452	0.781
	IIO2	0.282	0.585	0.529	0.039	0.058	0.916	0.585	0.862
Impact on downstream sales (IDS)	IDS1	0.140	0.293	0.235	0.036	0.024	0.315	0.812	0.609
	IDS2	0.165	0.497	0.398	0.074	0.136	0.632	0.910	0.854

Convergent validity was tested with the average variance extracted (AVE) as the criterion. AVE should be higher than 0.5, meaning that the latent variable explains more than half of the variance of its indicators [136-138]. As shown in Table 3, all constructs have an AVE higher than 0.5, meeting this criterion.

Discriminant validity of the constructs was assessed using two measures: Fornell-Larcker criterion and cross-loadings. The Fornell-Larcker criterion postulates that the square root of AVE should be greater than the correlations between the construct [137]. The cross-loadings criterion requires that the loading of each indicator should be greater than all cross-loadings [139-141]. As seen in Table 3, the square roots of AVEs (diagonal elements) are higher than the correlation between each pair of constructs (off-diagonal elements). The only exceptions are for the correlations between ERP value with both “impact on internal operations” (IIO) and “impact on downstream sales” (IDS). This phenomenon is expected since ERP value is a second-order construct of IIO and IDS. Table 4 shows that the patterns of loadings are greater than cross-loadings. Thus, this means that both measures are satisfied.

The assessments of construct reliability, indicator reliability, convergent validity, and discriminant validity of the constructs were all satisfactory, indicating that suggested constructs can be used to test the conceptual model.

5.2 Structural model

Structural equation modeling was used to estimate the competing models (additive, mediating, and moderator). Before the assessment of the models, we tested the multicollinearity of all constructs using the variance inflation factor (VIF), which ranged from 1.201 to 2.240. This value is below the conservative threshold of 5 [142]. To estimate the models, we generated 5000 resamples of bootstraps. Firstly, we estimated a model only with control variables. This model explains only 5% of the variation in ERP value (this model was not presented in Table 4). The first model presented in Table 5 is the additive model, in which ERP capabilities and ERP use explain 48.5% of the variation in ERP value. Second, to test the mediation of ERP use, we needed to estimate two models: block 1 and block 2. Block 1 explains 47.8% of the variation in ERP value based on ERP capabilities. In block 2, we added ERP use to explain ERP value. This model explains 48.5% of the variation in ERP value; capabilities also explain 22.3% of the variation in ERP use. Finally, the moderating model, which has ERP capabilities and ERP use as moderator, explains 49.5% of the variation in ERP value. Considering the adjusted R^2 , the moderating model is the one with the highest level.

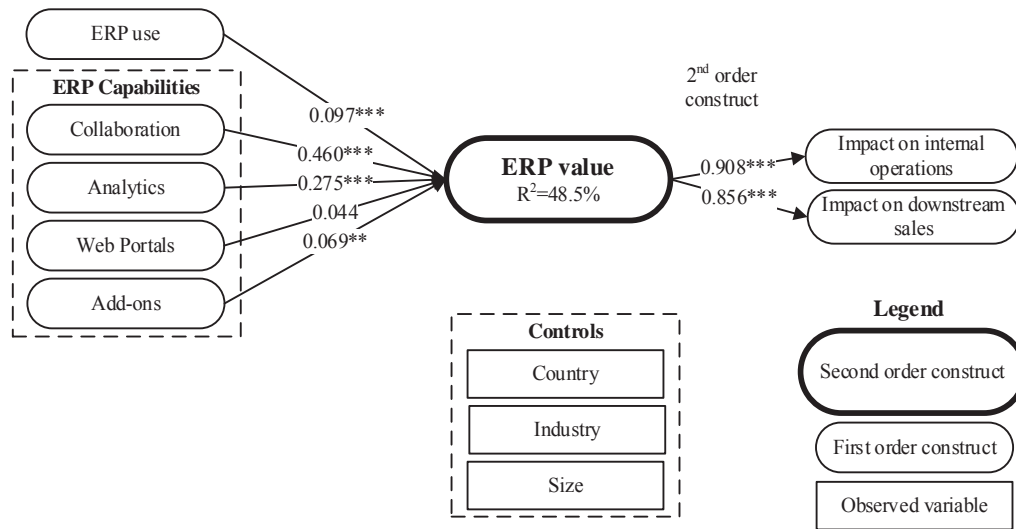
Table 5. Structural models results

	Additive model			Mediation model (block 1)			Mediation model (block 2)			Moderating model		
	Beta	R ²	Adj. R ²	Beta	R ²	Adj. R ²	Beta	R ²	Adj. R ²	Beta	R ²	Adj. R ²
ERP Value		48.5%	47.4%		47.8%	46.8%		48.5%	47.4%		49.5%	48.1%
ERP Use (ERPU)	0.097***						0.096***			0.102***		
Collaboration (Col)	0.460***			0.460***			0.465***			0.446***		
Analytics (An)	0.275***			0.303***			0.271***			0.249***		
Web-portals (WP)	0.044			0.038			0.042			0.039		
Add-ons (AO)	0.069**			0.083**			0.067*			0.067*		
Col*ERPU										0.009		
An*ERPU										0.100***		
WP*ERPU										-0.003		
AO*ERPU										-0.034		
country dummies	Included			Included			Included			Included		
Industry dummies	Included			Included			Included			Included		
Firm size	Included			Included			Included			Included		
ERP Use (ERPU)								22.3%	20.9%			
Collaboration (Col)							0.002					
Analytics (An)							0.280***					
Web-portals (WP)							-0.055					
Add-ons (AO)							0.153***					
country dummies							Included					
Industry dummies							Included					
Firm size							Included					

Note: To control data variation not explained by the other variables, we also included industry type, country, and firm size as control variables (Oliveira and Martins, 2010; Zhu and Kraemer, 2005).

Additive model - ERP use and extended ERP capabilities on ERP value

The results for the additive model of the effect of ERP use and extended ERP capabilities on ERP value are presented in Figure 4. The hypotheses of ERP use ($\hat{\beta} = 0.097$; $p < 0.01$), collaboration ($\hat{\beta} = 0.460$; $p < 0.01$), analytics ($\hat{\beta} = 0.275$; $p < 0.01$), and add-ons ($\hat{\beta} = 0.069$; $p < 0.05$) significantly affect ERP value. Only the ERP capability of web portals ($\hat{\beta} = 0.044$; $p > 0.10$) failed to indicate a significant effect on ERP value. This research model explains 48.5% of ERP value.

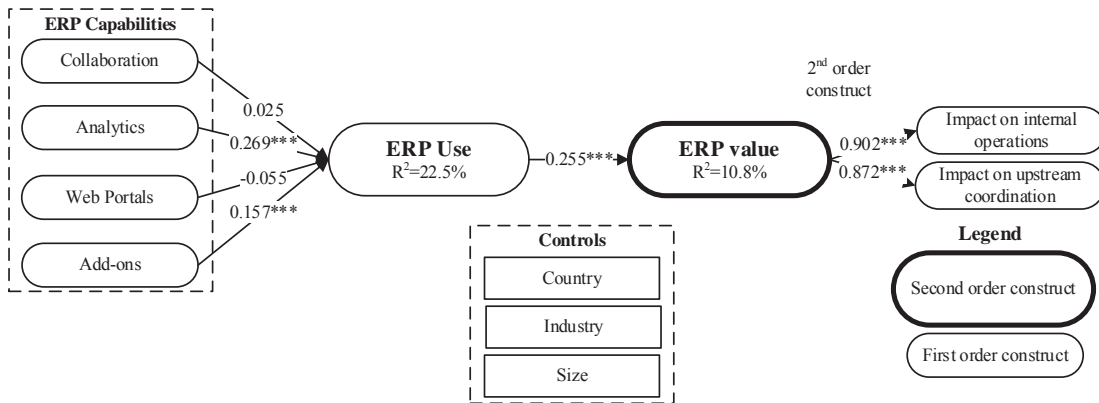


Note: *Significant at 0.10; ** Significant at 0.10; ***Significant at 0.10.

Figure 4. Additive model - ERP use and ERP capabilities on ERP value

Mediating model - mediating effect of ERP use between extended ERP capabilities and ERP value

The results of the mediation model are presented in Figure 5. To test if ERP use mediated extended ERP capabilities on the ERP value, we followed the Preacher and Hayes approach. First, we checked if only direct effects (without mediator, i.e., ERP use) significantly explain ERP value. Based on the mediation model (block 1), we can conclude that collaborations, analytics, and add-ons are statistically significant, meaning that ERP use can be a mediator. Second, we included the mediator variable, i.e., ERP use (see mediator model in block 2). We tested if the indirect effect of collaborations, analytics, and add-ons is statistically significant on ERP value. We conclude that only the indirect effect of analytics ($p < 0.01$) and add-ons ($p < 0.05$) are statistically significant. For this reason, we computed the variance accounted for mediation (VAF). The VAF are 0.09 and 0.18, respectively for analytics and add-ons, meaning that ERP use does not mediate the effect of ERP capabilities on ERP use.

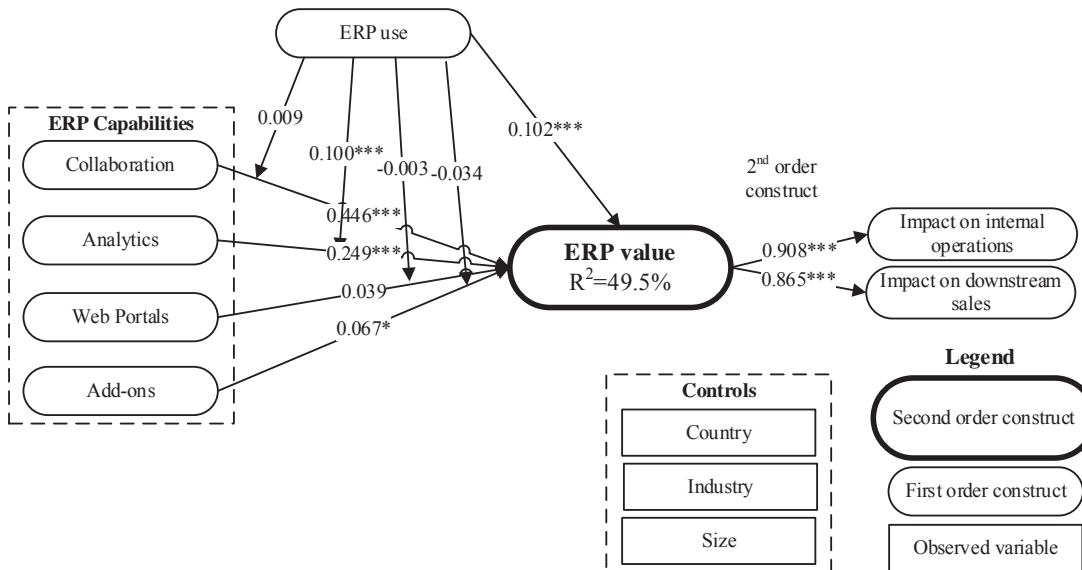


Note: *Significant at 0.10; ** Significant at 0.10; ***Significant at 0.10.

Figure 5. Mediating model - mediating effects of ERP use between ERP capabilities and ERP value

Moderating model - ERP Use moderates extended ERP capabilities on ERP value

The moderation model is presented in Figure 6. The ERP use ($\hat{\beta} = 0.102$; $p < 0.01$), collaboration ($\hat{\beta} = 0.446$; $p < 0.01$), analytics ($\hat{\beta} = 0.249$; $p < 0.01$), add-ons ($\hat{\beta} = 0.067$; $p < 0.10$), and the moderating effect of ERP use on the path between analytics and ERP value ($\hat{\beta} = 0.100$; $p < 0.01$) are statistically significant to explain ERP value. This research model explains 49.5% of ERP value.



Note: *Significant at 0.10; ** Significant at 0.10; ***Significant at 0.10.

Figure 6. Moderating model - ERP use moderates extended ERP capabilities on ERP value

To add further clarity to the moderating model, we split the data by low and high analytics and found that analytics is more important for ERP value when there is greater ERP use.

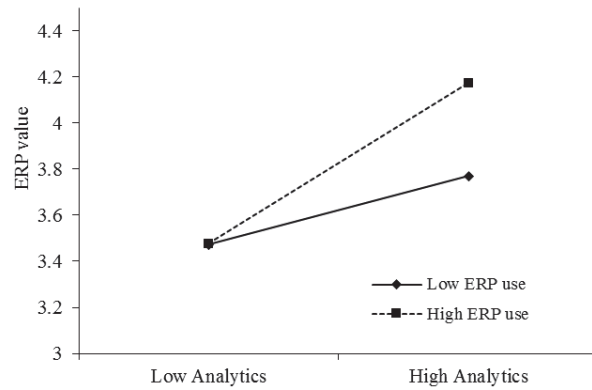


Figure 7. Predicted ERP value - Moderation effect of ERP use over the analytics to explain ERP value.

6. DISCUSSION

We evaluated three competing models in an effort to assess which of the models best justifies the relationship between extended ERP capabilities, use, and value. Specifically, the models tested are an additive model, a mediating model, and a moderating model. [Within the theoretical RBV framework](#), we find that they explain ERP value between 10.8 and 49.5 % (R^2). The models emphasize how ERP use and some extended ERP capabilities in the form of collaboration, analytics, web portals, and add-ons separately or together explain ERP value. From the analysis, it can be claimed that the moderation model [is a bit stronger in its explanatory power](#), because the adjusted R^2 is bigger (49.5%), than the additive model (48.5 %). As discussed in the previous section, due to the low explanatory power (10.8%) caused by the fact that ERP use does not mediate the effect of ERP capabilities on ERP value, the mediating model is not suitable to explain ERP value [142]. Next, we highlight the major findings and interpretations for each model.

Findings for the additive model

When exploring the relationships between ERP use, collaboration, analytics, and add-ons in the additive model, we found that they both show significant results to explain ERP value. Meaning, these are the ERP antecedents that have a positive impact on a firm's internal operations and downstream sales [73, 77]. For ERP use, firms with higher levels of usage of their ERP system tend to achieve a greater extent of ERP value, which is in line with Devaraj and Kohli [117] and Nwankpa [10] that claimed for studies that assess the link between system use and value. Among the extended ERP capabilities, Collaboration is the most significant factor, followed by Analytics and then the Add-ons. That is, firms with higher levels of Collaboration tend to achieve greater extent of ERP value which we empirically tested this factor that within ERP systems attesting previous claims that collaboration is an important antecedent for IT value, see for instance studies by Elbanna [17], Nwankpa [10] and Akkermans and Van-Helden [31]. As well as for Analytics, extending the literature with this confirmatory study [143] and [92], and Add-ons that are important extensions for IT value creation [47, 73].

Due to the significant paths of both Analytics and Add-ons extended ERP capabilities, this suggests that firms are more likely to wish these capabilities as native to ERP system and less so third-parties systems as previous studies by Negash and Gray [105] and Frolick and Ariyachandra [106] suggest.

The only relationship that is not significant in the additive model is the relationship between web portals and ERP value. Meaning that firms that utilize web portals as merely as an extension of ERP to push goods into the market do not have a positive and significant impact on a firm's internal operations nor the downstream sales. This suggests that an advanced extension, such as an e-commerce system tied with ERP, might be more appropriate to generate business value [144].

Findings for the mediating model

As theorized previously, looking to their significant and positive paths in Figure 5, this model shows that firms with higher levels of Analytics and Add-ons tend to achieve greater extent of ERP use, and higher levels of ERP use tend to achieve greater ERP value (which is in accordance with both additive and moderating models results). However, when looking at the respective adjusted R^2 , we found that Analytics and Add-ons are low in explaining ERP use (22.5%), and ERP use is low in explaining the ERP value (10.8%). Deepening the analysis through the VAF, we found that only the indirect effect of Analytics and Add-ons are statistically significant on ERP value, and for both variables, ERP use does not mediate the effect of them. Hence, these results show that ERP use does not mediate the extended ERP capabilities on ERP value.

This finding suggests that Analytics and Add-ons most likely generate ERP value when not mediated by ERP use. That is, as more and more firms conduct daily sales, services and procurement processes, operational analytic reporting, and extended functionality have been utilized as an integrant part of daily ERP use. It is indicating that these are capabilities that are being demanded as native of an ERP system to provide real-time decisions and not so much as third-party systems that are mediated by the use of ERP [108, 145]. This aspect confirms earlier studies that ERP actual use is a variable that needs to be continually studied as technologies advance as the "missing link" to IT payoff [38, 73, 117]. This significant linkage also supports our research design, in which use and value should be evaluated together through several models. That is, the above finding suggests that only direct or moderation effects are relevant, which impels us to study the direct and moderating models.

Findings for the moderating model

A part of the moderating role of ERP use, the findings of this model are mostly the same ones as from the additive model (hence, we will not repeat them here). Here we emphasize the difference - ERP use was found to have a significant and positive moderating role only in the Analytics capability. Meaning that as firms greatly utilize ERP in daily business operations more important is Analytics to increase business performance. This factor can probably be explained by the fact that if having a close connection (an integrated system) between analytics capabilities and the ERP system, as employees use the ERP system more, they also discover how to use and increase the usage of the analytics capability in the system [143]. Another explanation is that as more insights and operational reporting in real-time are requested, Analytics is a capability that is demanded to be embedded in the ERP systems [92]. Which that might imply that firms are looking to have an integrated OLTP + OLAP system, as Fay et al. [145] claimed.

While the adjusted R^2 for the additive model (48.5 %) is a bit lower compared with adjusted R^2 for the moderating model (49.5 %), and that they both show significant results for ERP use and extended ERP

capabilities, there is no significant difference between the relationships of these factors in these two models. However, when exploring the relationships between collaboration, analytics, and add-ons to ERP value in the additive and the moderating model, we found that the additive model shows higher significance between the extended ERP capabilities and ERP value compared to the moderating model.

This element suggests that within the postulated RBV framework, these results support that the proposed research models (additive and moderating) are a useful theoretical framework for explaining factors that affect the value of ERP by firms.

6.1 Managerial implications

The managerial contributions of this article are threefold. First, as ERP investments are a big challenge for the organization, and as such, it is of great importance to understand what it is that creates value. It is quite clear that without usage, even the best of ERP capabilities will not add to value. At the same time, decision-makers should understand that an investment in additional ERP capabilities can have a direct influence on ERP value gained. This observation suggests that not only does the value come from increased usage, but also the direct influence of new capabilities. *As demonstrated in the additive and moderating models that Collaboration, Analytics, and Add-ons are essential dimensions on which managers should focus.* Second, for an organization that then decides on implementing new ERP capabilities, it is crucial that these capabilities are used in new or changed business processes. If not, the investment might not deliver the value expected. *Whereas collaboration shows to be an important factor for firms putting their line of businesses and persons communicate, share, and so forth aligned towards improved operations and sales, Analytics and Add-ons are being demanded as capabilities part of ERP. That is, our results evidence that firms are looking for real-time analytics over ERP data, and vertical functionalities been part of ERP; hence, managers should revisit their third-party or fragmented legacy systems.* Third, as demonstrated in all three models, the study's results also caution organizational members against the purchase of the web-portal capability with their ERP, since it was not found to have any impact on the value. A possible explanation to this finding and something that decision-makers most likely should have in mind is that if the usage of ERPs goes in the direction of being used more directly by end-customers then a web-portal functionality will more likely have a positive effect. The result that the moderation model has the highest explanation on ERP value could definitely be explained by the fact that extended capabilities influence internal users, which are used to use the system without web-portal functionality, to higher and more elaborated usage of the ERP system. *The results also imply that managers should pay attention to possible use cases that an e-commerce system might pay off in some business processes than using web-portals.* The side effect of this is that the extended capabilities positively influences the gained value from the ERP system.

6.2. Research implications

The research contributions of this article are threefold. First, this is an original investigation, due to the complexity of ERP systems, the intangible nature of value, capabilities, and use of ERP, we conducted an evaluation based on a mixed-methods study (both quantitative and qualitative) for estimating the perceived value of ERP systems. Such an approach was argued to be essential for furthering research in ERP by Stefanou [146] as well as Shepherd et al. [147]. *The combination of methods has the potential of offering a*

more thorough and reliable development of theoretical knowledge. We believe we have responded to these calls by bringing clarity to the literature around the relationships between extended ERP capabilities and ERP value. Second, we developed an RBV-inspired understanding and testing three competing models surrounding these constructs. This paper advances the literature beyond testing and discussing results based on a single model such as the studies by Nwankpa [10] and Xu et al. [4]. The study empirically shows that the role of ERP use is more important when moderating the ERP capabilities with ERP value, as well as when additive to ERP capabilities, than when mediating between ERP capabilities and ERP value. The research indicates how to investigate added functionality to an already implemented IT system, which, in this case, was ERP systems. Moreover, studying ERP value from the RBV framework, we test that whereas both the additive and moderating models have the potential to explain ERP value, additive model might need to incorporate other non-technological resources such as organizational or environment Gupta et al. [148]. Such was argued to be necessary for furthering research in IS research by Sharma et al. [149]. Hence, the three presented research models could definitely be tested in another context, as well. Third, contrary to the vast majority of reported studies as discussed by Hsu et al. [49] and Petter et al. [150], we assessed the ERP value by using a second-order construct. In comparison to first-order with correlated factors, second-order factor provides a more parsimonious and interpretable model. Been able to validate the key factors of ERP value have on firms, which is an aggregation of ERP value across each of the dimensions: impact on internal operations and downstream sales. It follows logically that each of these two dimensions is independent of each other and cannot be interchanged. Such was argued to be important for furthering research in IS research by Petter et al. [150].

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APPENDIX A - QUESTIONNAIRE ITEMS

Construct	Item statement	Source	
ERP Use (ERPU)¹			
<i>Description</i>	<i>It refers to the extent to which ERP is used to support different daily activities such as supplier relations, production and operations, product and service enhancement, marketing and sales, and customer relations.</i>	Adapted from Zhu et al. [77] and Alhirz and Sajeev [114]	
ERPU1*	Please rate the degree to which your total procurement is conducted through the ERP.		
ERPU2	Please rate the degree to which your total services are conducted through the ERP.		
ERPU3	Please rate the degree to which your total sales are conducted through the ERP.		
Collaboration (Col)¹			
<i>Description</i>	<i>It enables an organization to increase firm performance with and from other organizations/individuals about existing and new business opportunities or means of creating more business value through ERP.</i>	Adapted from Ruivo et al. [38] and Ruivo et al. [25]	
Col1	Please rate the degree to which users were able to increase collaboration with colleagues for operational excellence and better service.		
Col2	Please rate the degree to which users were able to increase collaboration with the firm's information management system process and resource coordination.		
Col3	Please rate the degree to which users were able to increase timely communication with suppliers, partners, and customers to reduce waste in procurement and increase the firm's order fulfillment processes.		
Analytics (An)¹			
<i>Description</i>	<i>It refers to the way the decision-making process is established, based on information provided by ERP to support decisions.</i>	Adapted from Ruivo et al. [38] and Ruivo et al. [25]	
An1	Please rate the degree of comprehensive reporting (KPIs, Dashboards, etc.)		
An2	Please rate the degree of real-time access to information from querying or filtering the system.		
An3	Please rate the degree of data visibility across departments, such as through scorecards, dashboards, or notifications.		
Web-portals (WP)¹			
<i>Description</i>	<i>It refers to the ability to manage front-end business functions from ERP that provide real-time product information to consumers on the Internet, enable customization and self-service, thereby improving transactional efficiencies and expanding the existing channel.</i>	Results from the Delphi Study – capability definition adapted from Zhu and Kraemer [73]	
WP1	Please rate the degree to which the web portal supports the product catalog based on ERP.		
WP2	Please rate the degree to which the web portal supports account management based on ERP.		
WP3	Please rate the degree to which the web portal supports consumer customization based on ERP.		
Add-ons (AO)¹			
<i>Description</i>	<i>It enables increased functionality and extends the coverage of business processes managed by ERP, such as vertical modules specific for your industry or both local or global business requirements.</i>	Results from the Delphi Study – capability definition adapted from Nicolaou and Bhattacharya [47] and Zhu and Kraemer [73]	
AO1	Please rate the degree to which add-ons offer vertical functionality.		
AO2	Please rate the degree to which add-ons extend the firm's business processes.		
AO3	Please rate the degree to which add-ons are integrated with ERP.		
ERP value²	<i>Description</i>	<i>It refers to the impact that an ERP system has on business goals and business performance.</i>	Adapted from Zhu and Kraemer [73] and Zhu et al. [77]
	<i>Impact on internal operations (IIO)</i>		
	IIO1	Please rate the degree to which ERP improves internal processes.	
	IIO2	Please rate the degree to which ERP increased employee productivity.	
	<i>Impact on downstream sales (IDS)</i>		Adapted from Zhu and Kraemer [73] and Zhu et al. [77]
IDS1	Please rate the degree to which ERP widened the sales area.		
IDS2	Please rate the degree to which ERP improved customer service.		

Notes: ¹ Reflective construct. ² Formative construct. *Excluded after PLS estimation due to low loading.