Using insights from the contingent resource-based theory, this study proposes a conceptual framework that highlights how organizations can exploit ERP-enabled application integration to improve their overall post-implementation ERP benefits while examining the moderating effects of knowledge integration mechanisms. Specifically, the study proposed that existing ERP factors, namely current ERP performance and extent of ERP implementation, affect ERP-enabled application integration, which in turn influences overall ERP benefits. A firm-level survey was used to collect data, and structural equation modeling was used to test the hypotheses. The findings support the proposed hypotheses. Significant theoretical and practical implications of these findings are discussed.

KEYWORDS: ERP system benefit, ERP-enabled application integration, Knowledge integration Mechanisms.

INTRODUCTION

ERP systems are complex software solutions that integrate information and business processes within and across functional areas of business (Davenport 200; Kalling 2009). These systems represent a major departure from the legacy systems and functional information systems that were widespread in the past. According to Gartner, estimated investment in ERP systems worldwide was $24.9 billion in 2012 (Gartner report 2012). The reason an ERP system is so popular is that it enables process efficiency through information integration and its inherent business processes (Chou & Chang 2008; Nwankpa & Datta 2012). Although an ERP system boast of an integrated information system platform and promises “best practice” embedded business processes, there have been mixed results from ERP system implementations and use (Gattiker & Goodhue 2005). Indeed, the failure rate of ERP implementation and deployments ranges from 40 percent to 60 percent (Liang et al., 2007). One of the key challenges facing organizations after ERP systems implementation is understanding how to realize pre-implementation expected benefits. Some organizations have successfully implemented and benefited from their ERP system deployments (Nwankpa & Roumani 2014) and have indeed achieved operational efficiencies and other far-reaching positive changes (Hebert & Oppenheim 2004; Jones et al., 2008), while other organizations are left to grapple with ways to translate pre-implementation expectations into actual post-implementation benefits (Gattiker & Goodhue 2005). Despite a large body of ERP research literature from a number of different perspectives (Nwankpa & Datta 2012), most published research continues to struggle to adequately explain
these mixed results in post-implementation outcomes and benefits (Markus et al., 2000; Staehr 2010). As organizations continue to invest in ERP systems, the overarching question for management becomes how they can optimally realize the potential benefits from their ERP system.

ERP systems as platform technologies provide not only a common business process within the organization but also act an integrated platform that permits the adoption and integration of third party non-ERP applications (Fichman 2001; Liu et al., 2013; Nwankpa et al., 2013). Thus, organizations with ERP systems can leverage on this information superiority and integrate additional non-ERP applications such as e-commerce applications, customer relationship management (CRM) systems and supply chain planning systems. This level of integration enabled by an ERP system can extend functionalities such as connecting a website to an ERP system as well as advancing information visibility across an organization’s value chain (Nwankpa et al., 2013). For instance, integrating CRM and ERP applications can improve operational efficiencies by enabling value-chain processes to adjust promptly to each other (Liu et al. 2013). Firms with CRM applications and ERP systems are able to leverage the CRM applications’ ability to extract customer information from multiple customer touch points as well as the ERP systems’ ability to configure product offerings, scheduling, order fulfillment and interdepartmental information exchange (Liu et al., 2013). Ignoring this additional value attributable to CRM application integration with existing ERP systems can undermine the overall benefits of the ERP for a firm. Moreover, the ability to integrate non-ERP applications or other third party applications with add-on functionalities provides more options for organizations to respond to new challenges and remain agile in a competitive and dynamic business environment (Goodhue et al., 2009). Given the critical role ERP-enabled third party application integration, studies on ERP benefits that combine ERP-enabled application integration are needed to develop a better grounded theoretical understanding and devise more effective ERP benefit realization practices.

To this end, this study conceptualizes ERP system benefit and uses contingent resource-based theory as an analytical lens to understand how a firm can achieve overall post-implementation ERP benefit by linking the ERP with other non-ERP applications. This study sets out to examine two central research questions that have not been adequately investigated in the ERP benefit literature: (i) Is there a positive implication of ERP-enabled application integration on overall ERP benefit? And if yes, what are the antecedents of ERP-enabled application integration? (ii) Would ERP-enabled application integration impact on overall ERP benefit be contingent on the knowledge integration mechanisms? If so, how? This study attempts to answer these two questions by conceptually and empirically testing an integrated research model that combines the framework of ERP-enabled application integration and overall ERP benefits with survey data collected from employees in a wide range of United States firms.

Our focus on antecedents of ERP-enabled application integration and how ERP-enabled application integration influences overall ERP benefit sets this study apart from the mainstream ERP literature, which primarily offers an conventional view of ERP system benefits (Gattiker & Goodhue 2005; Chou & Chang 2008), thus limiting these models adequacy in explaining benefits that go beyond the boundaries of the existing ERP application. In addition, by showing how ERP-enabled application integration shapes overall post-implementation ERP benefits, this study has the potential to offer managers and top management practical insights into achieving ERP post-implementation expectations. In doing so, this study fills a significant gap in the ERP benefit research and practice – how organizations can leverage ERP system platform, integrate non-ERP third party applications and therefore achieve the benefits and expected outcomes. Finally, the examination of how knowledge integration mechanisms moderate the relationship between ERP-enabled application integration and overall ERP benefit not only enhances our
understanding of how these important factors work but also helps explain some discrepancies within ERP benefits literature.

The rest of the article is arranged as follows. The next section reviews the extant research on existing ERP system factors, ERP-enabled integration and ERP benefits, and based on this review the study will develop research hypotheses and propose a theoretical model. Next, a description of the research design and data collection, as well as data analyses using structural equation modeling is presented. Next, a discussion on the theoretical and practical implications of the findings, and finally, a brief discussion of the study’s limitations, conclusions and future research directions will be presented.

LITERATURE REVIEW

ERP system benefit

Despite a rich literature on ERP system benefits, the significant influences of ERP-enabled applications and overall ERP benefits have not attracted adequate attention in the ERP system literature. ERP system scholars have focused their attention primarily and understandably on immediate direct ERP system benefit – the operational performance of ERP firms compared to non-ERP firms - when studying ERP system benefits to adopting firms. Earlier studies on ERP benefits had mixed results. Poston and Grabski (2000) used archival data to examine a group of firms before and after ERP implementation and found no post-implementation general financial improvement. However, a subsequent study found that the financial performance of non-ERP adopters actually decreased over time while those of ERP adopters that remain unchanged (Hunton et al., 2003). Marbert et al., (2000) examined ERP system benefits in US manufacturing firms and found that although ERP use was pervasive in the US manufacturing sector, the system did not lead to significant operating expense reduction. On the contrary, Shang and Seddon (2002) demonstrated that the implementation of ERP systems resulted in significant operational benefits. They developed five dimensions of ERP benefits namely, operational, managerial, strategic, IT infrastructure and organizational. The authors concluded that ERP benefit realization was in fact a continuous process with specific benefits realized at different rates in different core processes and in different organizations. Also, O'Leary (2004) identified tangible and intangible ERP benefits and argued that benefits vary across industries, especially intangible benefits. Gattiker and Goodhue (2005) examined ERP benefits by applying a two-phased model that delineated intermediate ERP benefits and overall ERP benefits. They operationalized and measured intermediate benefits as “task efficiency” and “coordination improvement”. These benefits, they argue, will occur at the functional and operational levels within the firm but will contribute to the firm’s overall ERP benefits (Gattiker and Goodhue 2005). The authors concluded that realizing the intermediate benefits is critical to attaining the overall ERP benefits. Similarly, Chou & Chang (2008) decomposed these intermediate benefits in a bid to gain more insight and understanding. They found that customization and organizational mechanisms are key drivers of intermediate ERP benefits while reaffirming the role of intermediate benefits as predictors of overall ERP benefit.

ERP-enabled Application Integration

For the purpose of this study, ERP-enabled application integration refers to the extent of real-time communication between an ERP system and another non-ERP application. Such integration enables an organization to increase the visibility of an ERP system by leveraging the functionalities of third party applications with the cross-functional information exchange and
integration platform of an existing ERP system (Nwankpa et al., 2013). In a rapidly changing business environment, implementing an ERP system may not be enough to realize maximum anticipated benefits. Application integration enables organizations to remain agile and responsive to their companies needs and keep pace with technological leaps and innovations. Through application integration, firms can extend and enhance functionalities, exchange information with a firm’s existing ERP system and better increase visibility throughout the entire value chain (Rai et al., 2006). The extant literature has rendered some support for ERP-enabled application integration. For instance, firms adopting both an ERP system and a CRM application achieved significant improvement compared to firms adopting only an ERP system (Aragon-Correa & Sharma 2003). Similarly, the integration of CRM applications and customer facing business processes of Dell and IBM with their respective ERP systems enabled the collaborative planning and coordination of their entire corporation value chain and service delivery (Sambamurthy et al. 2003; Liu et al. 2013). ERP vendors have also recognized the importance of application integration and are now providing platforms and interfaces that are friendly with third party application integration (Nwankpa et al., 2013). SAP ERP 6.0 and Oracle e-business suites are built on service-oriented architecture (SOA) framework that enables easier application integration and package enhancement. In fact, SAP business suite 7 comes with four enhancement packages consisting of customer relationship management (CRM), supply chain management (SCM), project lifecycle management (PLM) and supplier relationship management (SRM), all designed using service oriented architecture for easy integration with the ERP system core. Firms are increasingly viewing the initial ERP implementation as a base technology, and once this technology core is stabilized, it provides an opportunity for firms to integrate additional applications such as data warehouse, data mining solutions and web enabled e-commerce applications (Willis & Willis-Brown, 2002). Therefore, it is vital that we extend the ERP benefit literature by developing a model that accommodates the add-ons and integrations created by the existing ERP system.

THEORETICAL DEVELOPMENT

A contingent resource-based theory

Contingent resource-based theory is an extension of the resource-based theory and describes how a superior organizational performance is a result of the proper alignment of primary resources and secondary resources (Brush & Artz 1999; Chae et al., 2014). While the resource-based view of the firm provides a theory that explains competitive advantage as an outcome of the design and improvement of valuable firm capabilities, contingent resource-based theory asserts that the value of the resources might be contingent on different contexts and may depend on the linkage between primary resources and conditional variables (Brush & Artz 1999; Aragon-Correa & Sharma, 2003). For instance, while ERP systems have been recognized within the literature as vital resource, empirical results have been mixed regarding the overall ERP benefits (Nwankpa & Roumani, 2014; Hebert & Oppenheim 2004; Gattiker & Goodhue 2005). More studies have advocated the inclusion of contingency variables as necessary variables in the assessment of competitive value of firms’ resources and capabilities (Aragon-Correa & Sharma 2003; Chae et al., 2014). Such studies argue that important resources rarely operate in isolate in creating value and competitive advantage thus, paying attention to the role of other secondary resources may adequately capture the linkage and value of firms (Wade & Hulland 2004; Chae et al., 2014). Indeed existing empirical studies have assessed the role of some secondary variables on vital resources and found that these complimentary variables had moderating effects. For instance, the impact of IT resources on firms’ capabilities is moderated by financial strength of such firms (Luo et al., 2012) while a study on veterinarians found that the
value of practice capabilities was contingent on the type of service being offered and the intrinsic information asymmetry between the client and service-provider (Brush & Artz, 1999). The perspective taken in this research is that ERP systems are important resources but may yet depend on the linkage with ERP-enabled application integration in creating sustainable overall ERP benefits. Thus, the ability of an organization to explore the richness of an ERP system may be hindered by the role of other secondary or non-critical resources. Based on the theory, ERP benefits are consequences of an organization’s ability to apply a set of non-critical resources that extend the visibility and functionality of the ERP. Therefore, contingent resource-based theory can be used as the theoretical foundation for our research model, in which an organization’s ability to achieve overall ERP benefit is contingent upon recognizing, exploring and integrating ERP-enabled applications with the existing ERP system.

RESEARCH MODEL AND HYPOTHESES DEVELOPMENT

Building on the background literature discussed above, the following section presents the research model underlying our study in Figure 1. The reasoning for the key links in the model and the specific hypotheses are discussed below.

![Research Model Diagram]

Figure 1: Research Model

**Current ERP Performance**

ERP system performance refers to the degree of effectiveness and efficiency in realizing business goals and objectives by an ERP system (Leem & Kim 2004; Nwankpa et al. 2013). Current ERP system performance examines the existing ERP system’s ability to meet the requirements of the current business functions and activities as well as anticipated future requirements (Nwankpa et al. 2013). At the post-implementation phase of an ERP system, it is vital for organizations to examine the performance of their ERP system as it provides a sense of future direction on how firms can strategically apply the system. Prior research on ERP system performance has revealed important findings for ERP implementing firms. Wei (2008) argued that to evaluate the performance of an ERP system, organizations need to first identify key performance indicators and expectations. Although the reason behind an ERP implementation may vary across companies and industries, organizations appear to converge on the
performance and expectations of ERP systems. ERP system performance is result oriented and shaped by system quality, information quality, reliability, usage, user satisfaction, individual and organizational impact (Tsai et al. 2010). The system is expected to provide real-time access to information and common business processes for cross functional areas of business within an organization (Nwankpa & Roumani, 2014). At the application level, prior research on ERP performance found that firms implementing more ERP modules attained stronger ERP performance compared to firms with fewer ERP modules (Hitt 2002; Nicolaou 2004). Current ERP performance has also been linked with application integration and extension of ERP functionalities. Willis & Willis-Brown, (2002) noted that the underlying ERP system needs to be stable and operating at an acceptable level of performance for third party application integration to take place. If the core ERP system is underperforming or unstable, firms may be hesitant to integrate and extend applications and functionalities as such applications rely extensively on the ERP system platform. Thus, stabilizing the core ERP system enables organizations to successful leverage the common database structure of the system. Such firms can extend the reach of their ERP with add-ons such as SCM, data warehouse applications and web-enabled applications (Nwankpa et al. 2013). Therefore, this study contends that current ERP performance will impact ERP-enabled application integration as organizations will view the existing ERP performance as an indicator of how well other ERP-enabled applications align with the ERP. Thus, the study proposes the following hypothesis:

H1: For an ERP implementing firm, current ERP performance will positively affect ERP-enabled application integration.

Extent of ERP Implementation

The extent of ERP implementation refers to the scope of the initial ERP implementation and can be viewed as reach and scale of the initial ERP deployment. ERP systems have modular and divisible characteristics that create a variety of options to consider during ERP implementation. For instance, firms can choose to deploy a certain number of ERP modules within a particular enterprise subunit or within a given geographical spread. Similarly, the deployment strategy can be a big bang implementation, a phased rollout or a mini-big bang deployment depending on certain organizational factors (Marbert et al. 2000). The extent of ERP implementation has come under scrutiny as researchers attempt to explain variance in ERP benefit realization (Karimi et al. 2009; Ruivo et al. 2012; Nwankpa et al. 2013). For instance, the examination of the impact of ERP investment on market value of firms found that firms implementing ERP systems with greater functional, organizational and geographic scope had positive and higher shareholders returns while firms implementing ERP projects with lesser scope generated negative returns (Ranganathan & Brown 2006). Similarly, the extent of ERP implementation has been found to influence business process outcomes. Karimi et al. (2007) noted that firms will require a certain level of depth in the initial ERP implementation to create the platform necessary to facilitate higher business process outcomes while prior research found that the extent of ERP implementation created the suitable platform for organizational ease of use of subsequent technologies (Nwankpa et al. 2013). Thus, the extent of ERP implementation this study argues will underpin how add-ons and ERP-enabled applications can be supported and integrated. This leads to the following hypothesis:

H2: For an ERP implementing firm, extent of ERP implementation will positively affect ERP-enabled application integration.
Impact of ERP-enabled application integration on overall ERP benefit

Prior research has not addressed the direct impact of ERP-enabled application integration on ERP benefits. However, existing literature suggest that platform technologies such as ERP systems enable the adoption and integration of subsequent applications and add-ons (Fichman 2004; Karimi et al., 2009; Nwankpa et al., 2013). These additional applications allow firms to extend functionalities and remain agile, strategic and responsive to changing technological opportunities. Willis & Willis-Brown (2002) argued that for organizations to realized full ERP benefits, they need to view the initial ERP implementation as a foundation laying exercise that creates the opportunity for organization to integration emerging technologies. Such a view was reinforced by Bread & Sumner (2004) who noted that the integration of CRM and e-commerce capabilities are valuable to firms due to the enabling base technology and backbone support provided by the ERP systems. Firms who do not extend the functionalities of their ERP systems or integrate their ERP systems with additional applications may not lay claims to the same overall ERP benefits (Nwankpa et al. 2013; Liu et al. 2013). These system add-ons provide very specific functionalities capable of creating a wide range of different capabilities that firms can attach to their ERPs in order meet and respond to emerging business challenges (Goodhue et al. 2009). Moreover, Aral et al., (2006) revealed that firms implementing both ERP and CRM applications had higher performance improvement compared to those of firms adopting only ERP applications. Thus, this paper argues that in a post-implementation phase, ERP-enabled application integration will enable firms to achieve higher overall ERP benefits by providing add-on solutions and specific non-critical functionalities yet necessary to meet emerging organizational needs. In addition, this paper argues that knowledge integration mechanisms will moderate the relationship between ERP-enabled application integration and overall ERP benefit. Consistent with contingent resource-based theory, firms lacking complementary resources and variables may absorb external knowledge about ERP-enabled applications but fail to realize its value and may be ill-equipped to align secondary applications to their existing ERP systems. The availability of knowledge integration mechanisms within the firm enables efficient alignment of ERP-enabled applications with the existing ERP, leading to aggregate ERP benefits. This leads to the following hypotheses:

H3: For an ERP implementing firm, ERP-enabled application integration will positively affect overall ERP benefit.

H4: For an ERP implementing firm, the relationship between ERP-enabled application integration and overall ERP benefit is positively moderated by the availability of knowledge integration mechanisms.

Control variables

Technology adoption and assimilation processes are subject to various other organizational influences (Fichman 2001). To minimize the confounding effect of spurious correlation, this study included firm size and time elapsed since ERP system implementation as control variables. Firm size is often an important control variable as it is found to determine firm performance and innovativeness (Rai et al. 2006; Kim & Lee 2010). Larger firms can benefit from economies of scale arising from available human capital and financial resources. In addition, the duration, measured by the length of time elapsed since the firm implemented the ERP system, is included as a control variable when testing the effect of ERP-enabled application integration and other ERP factors on overall ERP benefit.
RESEARCH METHODS

Sample

The firm is the unit of analysis in this study as such the subjects are IT decision makers within the organization such as, the chief information officer (CIO), chief technology officer (CTO) or vice president of IT operations. These executives are typically tasked with the decisions making processes of their organizations technology needs. Dun and Bradstreet’s Million Dollar database (Cooper et al. 2000; Ray et al. 2005; Tiwana et al. 2006) – a directory of executives was used to identify a random sample of IT executives. This database provides contact information of executives in various positions in firms in the United States. This database was used to identify a random sample of information systems executives holding IT positions in companies the United States. A qualifying factor in their selection was their organizations use of ERP systems in their operation. An additional qualifying factor was that the firm had to utilize an additional application supported and enabled by the existing ERP system. The survey instrument was developed and adapted after a thorough literature review and interviews with some IT managers. The preliminary survey was reviewed by three faculty members and three doctoral students actively involved in ERP systems research and by five IT managers. These steps ensured face and content validity of the measurement items. The modified questionnaire was pilot-tested and went through some iterations before being used in the actual survey. A small scale pretest of the questionnaire was mailed to a random sample of 250 IT executives. The respondents were instructed to indicate their level of agreement with a statement using multiple indicators coded on a seven-point Likert scale. Furthermore, a comment box was provided and respondents were asked to provide feedback and comments on the items. A total of 45 responses were returned. Preliminary confirmatory factor analysis indicated a clear factor loading and internal consistency on the hypothesized dimensions as a result no further modification was made before the final questionnaire was mailed. This study used a cross-sectional firm-level survey and data were collected through a mail survey. Questionnaires were mailed to 1250 corporations in the United States that were selected randomly from Dun and Bradstreet’s Million Dollar database. A total of 287 responses were returned in the first mailing. Phone calls were made to about 550 randomly selected nonrespondents and where possible voice mail messages were left explaining the nature of the research and requesting the contacts participation. An additional 58 usable surveys were received from a second mail providing a total of 345 responses. Out of 345 responses 317 were usable, resulting in an actual response rate of 25.3%.

Operationalization of constructs

Whenever possible, this study used previously validated measures and adapted them in the context of ERP system benefit and ERP-enabled application integration. In the absence of existing scales, theoretically grounded new scales were developed. Similarly, the items for measuring current system performance were adapted from Nwankpa et al. (2013) while the items measuring extent of ERP implementation were adapted from Karimi et al. (2007). Conversely, the seven items measuring knowledge integration mechanisms were adapted from Teo & Bhattacharjee (2014) while the three items measuring overall ERP benefit were adapted from Chou and Chang (2008). In the absence of an existing scale measuring ERP-enabled application integration, these measurement items were developed based on prior literature on ERP-enabled adoption (Nwankpa et al. 2013; Liu et al. 2013). These items were measured with multiple indicators coded on a seven-point Likert scale. In addition to the focal constructs, the
study measured demographic characteristics of each respondent and the time elapsed since the ERP implementation.

DATA ANALYSIS AND RESULT

Data analysis and empirical validation of our hypotheses were done with partial least square (PLS) analysis. PLS was selected because it enabled specification and testing of path models with latent constructs and because it places minimal restriction on the measurement scales, sample size and residual distribution (Chin & Newsted 1999). Further, PLS allows latent constructs to be modeled as formative indicators as was the case with our data. SmartPLS 2.0 (Ringle et al., 2005) software was used for the analysis. SmartPLS 2.0 performs bootstrapping analysis to assess the statistical significance of the loading and path coefficients (Ringle et al. 2005). Consistent with prior research using PLS models, this study analyzed the research model in two stages (Hulland 1999; Chin 2001; Gefen & Straub 2005). The first stage involved the assessment of the reliability and validity of the measurement model and the second stage involved the assessment of the structural model (Hulland 1999).

Assessment of Potential Response Bias and Common Method Bias

To ensure that the responses in the sample are free from non-response bias, this study followed a procedure by dividing the sample into two groups based on the time when each response was returned. Using this procedure, it was possible to determine statistically whether later respondents were significantly different from earlier respondents. The result did not show any significant differences between the two groups, indicating that non-response bias was not a significant issue that could confound the findings of this study. The survey questionnaire was completed by a single respondent thus, it was important to assess the potential of common methods bias. Following Podsakoff and Organ (1986), this study applied the Harman's one-factor test on the constructs by simultaneously loading all items from the combined data set in factor analysis with no rotation. Results showed that the most covariance explained by one factor was 37.22%, suggesting that common method bias was not likely present in the study. Also, the study applied the Liang et al. (2007) procedure to test the common method bias in PLS. The results revealed that method loadings were insignificant and that indicators variances were considerably greater than their method variance. Thus, this study concluded that the common method bias was not a serious threat to this study.

Measurement model

The adequacy of the measurement model was assessed by evaluating the results of content validity, criterion-related validity, convergent validity, construct validity and reliability tests (Boudreau et al. 2001; Straub1989). Content validity is defined as the degree to which the items represent the construct being measured. Content can be assessed by the domain experts and through review of prior literature (Straub et al. 2004). As noted earlier, the preliminary questionnaires were sent to and examined by a panel IT professionals in ERP implementing organizations as well as by researchers in the area. The questionnaire was then modified based on inputs from these experts. Content validity was thus established by examining prior literature, developing and adapting to existing scale and using a panel of IT professionals and researchers within the area to judge the quality of the instrument (Cooper & Schindler 1998). Criterion-related validity is the extent to which the survey instruments are related to concrete criteria. The expected cross validity index (ECVI) which one measure for criterion related validity was used for all the constructs in this study and the ECVI values which well below the acceptable value of
Confirmatory factor analysis was conducted for all of the latent constructs in the model (Table 1). All item loadings were greater than .60 as recommended by Hair et al. (1998). Thus, the items are representative of their respective constructs. Furthermore, the reliability of the scales and measurement items were evaluated. The reliability of the scales is indicated by the composite reliability (CR) values and Cronbach’s alpha in Table 2 and all values are above the acceptable 0.7 threshold (Nunnally 1978), thus all measures have adequate levels of reliability. Construct validity can be assessed using convergent validity and discriminant validity. Researchers achieve convergent validity when scores of items used to measure a construct correlate with or are related to scores of other items designed to measure the same construct (Campbell & Fiske 1959). Convergent validity was tested using two criteria (Fornell & Larcker 1981). First, all indicator loadings should be significant and exceed 0.7 and second, the average variance extracted (AVE) by each construct should exceed the variance due to the measurement error for that construct. As shown in Table 1, all of the items exhibit a loading higher than 0.7 on their respective construct, and as shown in Table 2 were greater than 0.70, thus satisfying both conditions for convergent validity. The variance inflation factor (VIF) examined the existence of excessive multicollinearity among latent constructs. All VIF measures were below the 5.0 recommended minimum (Kline 1998) and the highest VIF value was 2.76.

**Table 1: Loading and cross-loadings**

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<tr>
<th></th>
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<th>EEI</th>
<th>EAI</th>
<th>KIM</th>
<th>OEB</th>
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</tbody>
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Discriminant validity examines the degree to which a measure correlates with measures of constructs that are different from the construct the measure is intended to assess (Barclay et al. 1995). This would imply that the construct does not share much variance with other constructs, rather with its own measures. Discriminant validity was assessed using three tests. First, an examination of cross factor loadings (Table 1) indicates good discriminant validity, because the loading of each item on its assigned construct is greater than its loadings on all other constructs (Chin 1998), suggesting discriminant validity. Second, the correlations among the constructs are below the 0.85 threshold (Kline 1998), suggesting discriminant validity. Third, the square root of the AVE from a construct is greater than the correlations among the construct and all other constructs in the model (Table 2) (Fornell & Larcker 1981).

| Table 2 Construct correlations, consistency and reliability |
|------------------|---|---|---|---|---|---|---|
|                 | AVE | CR  | α   | CEP | EEI  | EAI  | KIM  | OEB |
| CEP             | 0.90 | 0.96 | 0.94 | 0.94 |       |      |      |     |
| EEI             | 0.88 | 0.94 | 0.90 | 0.41 | 0.93 |      |      |     |
| EAI             | 0.88 | 0.93 | 0.91 | 0.37 | 0.39 | 0.93 |      |     |
| KIM             | 0.90 | 0.94 | 0.90 | 0.44 | 0.32 | 0.36 | 0.94 |     |
| OEB             | 0.90 | 0.95 | 0.91 | 0.41 | 0.42 | 0.42 | 0.35 | 0.94 |

Bold numbers on diagonal are the square root of the AVE

Structural model

In PLS analysis, examining the structural paths and the R-square scores of the endogenous variables assesses the explanatory power of the structural model. Figure 2 shows the results of the structural path analysis. Overall, all of the 4 paths are significant, with a p-value of less than 0.05. The model explained 25% of the variance in overall ERP benefit. Similarly, task efficiency, current system performance, extent of ERP implementation and coordination improvement explained 34% of the variance in ERP-enabled application integration. The control variables (i.e., firm size and time elapsed since ERP implementation) showed no significant influence on ERP-enabled application integration and overall ERP benefit. This indicates that overall ERP benefits are better explained by the independent variables in the research model than by difference among the respondents.
DISCUSSION AND CONCLUSIONS

Achieving overall ERP benefits has remained elusive for many ERP implementing firms. Despite significant body of research on ERP benefits realization, insights regarding the antecedents of ERP-enabled application integration, the relationship between ERP-enabled application and overall ERP benefits are lacking in the literature. The goal of this study was to understand organizational integration of ERP-enabled applications and how such application integrations shape overall post-implementation ERP benefits. The research model, estimated with survey data from 317 firms, finds good overall support. The results indicate that current ERP system performance and extent of ERP implementation influence ERP-enabled application integration. Furthermore, an insight emerging from this study is that ERP-enabled application integration has a strong effect on overall ERP benefit. This finding is particularly important because it suggests that overall ERP benefits from post-ERP implementation may lie in part on the ability to integrate other applications enabled by the existing ERP platform. Thus, firms will be better served if they move beyond the inherent benefits and system functionalities directly linked with their existing ERP systems and rather explore ways to integrate new emerging applications. By aiming at leveraging the information robustness and cross functional integration capabilities of a current ERP system, organizations can extend the overall benefits of their ERP system.

Consistent with this study, knowledge integration mechanisms moderate the influence of ERP-enabled application integration on overall ERP benefit. The importance of ERP-enabled application integration as a predictor of overall ERP benefits increases when knowledge integration mechanisms increases. Thus, firms with effective knowledge integration mechanisms are able to create good alignment between the ERP and additional applications, leading to aggregate overall ERP benefits.

Theoretical contributions

This research project is the first to apply ERP-enabled integration and contingent resource-based theory to ERP system benefit, representing a theory-based extension to an area of study which is important both to researchers and practitioners. The current study advances the theory-building process by developing and validating the new construct and by empirically testing a research model that connects ERP-enabled application integration with a number of its antecedents and outcome variable. Furthermore, the current study empirically validates this
integrated model. All the hypotheses were supported and these results attest to the value of this research model. The study provides evidence that ERP-enabled application integration influences overall ERP benefit. Since prior literature on ERP benefit has limited such investigations to research models within the boundaries of the ERP system, this work furthers our understanding of ERP benefits. Furthermore, this work demonstrates the value of having appropriate knowledge integration mechanisms within an organization when integrating other applications with ERP system core. Although prior research has identify the important role of knowledge integration mechanisms (Mitchell 2006; Teo & Bhattacherjee 2014), this study develops and tests the moderating role of knowledge integration mechanisms and the insights provides a useful theoretical basis for understanding variances in outcomes after ERP implementation. Finally, although the current mainstream literature on ERP benefit has put a strong emphasis on unmasking the implementation challenges that hinder desired ERP outcome (Esteves 2009; He 2004), this study calls for attention to how ERP-enabled application integration influences the overall ERP benefit, thus complementing the current literature by expanding the horizon and developing better theories.

Practical Implications

This research makes a number of contributions to practice. The ERP-enabled application integration approach complements and extends the work done by many managers to successfully implement and generate the expected benefits of their organizations ERP system. The ERP-enabled application approach goes beyond the conventional ERP critical success factors and standard operating procedure by emphasizing the need to view an ERP system as a platform technology rather than as just another technology application. Moreover, from an evaluation perspective, viewing an ERP system as a foundation platform technology can enhance the justification of ERP system projects because this study has shown that an ERP system can give an organization the ability to adopt emerging technologies and the capacity to extend values and benefits outside the parameters of the initial ERP system. By incorporating ERP-enabled integration into an organizations strategic plan, IT managers can overtime leverage their ERP systems, extend functionalities and keep pace with technological leaps and innovations. The significant relationship between ERP-enabled application integration and overall ERP benefit suggests that managers who endeavor to seek ways to integrate add-ons and other ERP-enabled applications can significantly improve the overall ERP benefit, which can have a strong impact on organization overall performance (Velcu 2007). Indeed, ERP vendors are already supporting the technical aspects of this ERP-enabled integration but IT managers and firm management will need to provide the organizational support needed to foster such integration with third party applications. This study found that these supports may come from taking steps to ensure optimal ERP performance, ensuring adequate alignment of the ERP system with organizational tasks and routines and streamlining the business processes to enable improved inter-department coordination within the organization. Similarly, this study further underscores the need for firms to have strong knowledge integration mechanisms in place. ERP systems are complex technologies capable of creating integration challenges. Therefore, firms need to develop a reliable process of knowledge acquisition, transfer and dissemination to accelerate the process of achieving overall ERP benefits from ERP-enabled integration. In sum, this work suggests that firms should pay attention to their ERP system’s current performance and extent of implementation as such factors are important predictors of ERP-enabled application integration and overall ERP benefit respectively.
Limitations and future research

There are limitations to this study that should be pointed out. First, the generalizability of our study is limited, as the empirical data were collected from one key respondent in each firm and came from a single country. This could potentially lead to the percept-percept inflation problem [16]. However, this concern is partly alleviated in our context for several reasons including the depth of involvement of these respondents in management responsibilities and operations of their respective firms. Also, the results from Harman’s single-factor test suggest that common-method bias does not influence our results. Given that respondents came from a single country, ERP benefits, national and cultural particularities need to be analyzed in future research. One suggestion, will be introducing organizational culture as a moderator in the influence of ERP benefits. Second, this study adopts a cross-sectional view in measuring the constructs. Thus, such a design may not adequately capture the interactions among the constructs and cannot establish causality. Future research might find it useful to measure these variables from multiple points in time. A more rigorous test of our model will involve a longitudinal study. Such a study may enrich the findings of our results as well as establish the causality of argument. Nonetheless, the theory in this study suggests that the relationships tested in the research model are causal in nature.

Conclusion

As firms continue to invest in ERP systems to integrate information and streamline business process across functional areas, it has become increasingly critical to understand how expected ERP benefits can be attained. Drawing upon contingent resource-based theory framework and grounding our research in practitioner interviews, this study develops a inclusive model, which examines both antecedents and consequences of ERP-enabled application integration and extends the our understanding of overall ERP benefits. The results from the empirical evidence show that current ERP performance and extent of ERP implementation positively influence ERP-enabled application integration. The study also finds that ERP-enabled application integration is key determinants of overall ERP benefits. The results further show that the knowledge integration mechanisms moderate the impact of ERP-enable application integration on overall ERP benefit. Although ERP-enabled application integration influences overall ERP benefit, the importance of ERP-enable application integration as a predictor of overall ERP benefit increases when knowledge integration mechanisms increases. These results contribute to a stream of research that examines the overall ERP benefit at the post-implementation stage.
REFERENCES:


Nwankpa & Roumani

ERP-enabled application integration on ERP benefit


