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ERP system usage and benefit: A model of antecedents and outcomes

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ABSTRACT

ERP system usage has been identified as a critical factor in attaining the benefit from an ERP installation. However, the specific antecedents of ERP usage and its impact on ERP benefit remains largely unknown. Drawing on absorption capacity theory, this study develops a theoretical model that examines the mediating effect of ERP system usage on ERP benefits. Similarly, the study also identifies the antecedents of ERP system usage. A model is tested using the responses of 157 ERP system end-users across the United States and the results suggest that ERP system usage is directly related ERP benefit. However, the relationship is moderated by the degree of knowledge integration mechanisms within the firm. Consistent with the proposed model, the results also reveal that technical resources, organizational fit and the extent of ERP implementation are key drivers of ERP system usage. The research findings advance our knowledge on how managers can enhance ERP usage and realize optimal ERP benefits.

1. Introduction

ERP systems have drawn increasing attention within the last two decades as firms continue to seek ways to gain strategic and competitive advantage with these technologies. ERP systems are complex software packages that integrate information and business processes within and across functional areas of business (Davenport, 2000; Kalling, 2003). One area that continues to elude practitioners and researchers alike is how to realize the full benefits and value from an ERP investment. With huge amount of resources invested in the initial ERP deployment, firms are increasingly eager to translate this investment into an organizational success. However, studies have shown equivocal results for ERP implementing firms. On the one hand, some businesses have achieved operational efficiencies and other positive changes through ERP deployment. On the other hand, some companies are left to struggle with translating pre-deployment expectations into actual ERP success. One area that has come under scrutiny as a possible explanation to ERP success variances is the level of ERP usage among implementing firms. ERP implementing firms continue to grapple with low usage from ERP end-users. Poor ERP system usage has been linked to poor understanding of ERP systems causing firms maintaining parallel shadow systems and end-users to create workaround leading to delayed migration (Markus & Tanis, 2000).

Prior research has identified information system (IS) usage as a key predictor of technology adoption success (Leem & Kim, 2004). Although ERP system configuration is generic and resides for the most part with ERP vendors, the process of appropriating and using these packages can be influenced by organizational factors. Such factors if not adequately addressed are capable of limiting the use of ERP systems. A large body of ERP research literature has identified critical factors that foster successful ERP system implementation. However, understanding the conditions that can enhance optimal ERP system usage at the post-implementation phase has been largely ignored in the literature. This study is unaware of any theoretically grounded research that explains which antecedent and consequence factors of ERP system usage. As a result, it is unclear which managerial actions and interventions can best promote ERP usage and subsequently ERP benefits. To develop a deeper understanding of these varying outcomes of ERP system implementations, this study contends that those firms that facilitate ERP system usage after the initial ERP implementation are more likely to benefit from their ERP initiatives than firms that do not.

This study proposes a model that captures key antecedents and consequence of ERP system usage and then empirically tests the hypothesized model using data from a field survey of end-user in US firms that have implemented ERP systems. This study sets out to examine two central research questions that have not been adequately investigated in the ERP usage and benefit literature: (i) Is there a positive implication of ERP system usage on ERP benefit? And if yes, what are the antecedents of ERP system usage? (ii)

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Would ERP system usage impact on ERP benefit be contingent on the knowledge integration mechanisms? If so, how? The article contributes to the literature in a number of ways. First, it moves away from implementation-centric research on ERP systems to organizational internal factors, an important step in building collective knowledge in this line of inquiry. Second, this paper provides a theoretically based understanding and explanation of how organizations can enable or constrain the usage derivable from an ERP implementation. Finally, the study provides guidance for managers who grapple with ways to increase the usage and benefits of their existing ERP systems.

The paper is structured as follows. First, a review of relevant literature on ERP system usage, technical resources, organizational fit, Extent of ERP implementation and ERP benefit. Second, a development of the hypotheses about causal relationships between critical concepts is introduced. Next, a presentation of the research model and a description of the research method. Finally, the results of the empirical investigation are outlined as well as a discussion of the results and contributions to research and theory.

2. Theoretical background

2.1. Absorption capacity theory

Given that ERP systems are complex information systems yet capable of creating operational efficiency through business process and data integration (Trinh-Phuong, Molla, & Peszynski, 2012), organizations need to find ways to acquire, assimilate and exploit the system to meet the ever-changing and competitive business environment. Absorption capacity theory has been widely applied to explain how firms use and apply technological information (Gosain, Malhotra, & El Sawy, 2004; Park, Suh, & Yang, 2007). Absorption capacity theory suggests that firms who can recognize the value of new external information and knowledge, assimilate and use it toward achieving organizational objectives are more likely to be more innovative, flexible and productive (Cohen & Levinthal, 1990). The theory assumes that firms with higher capacity to absorb new knowledge will have a higher level of performance over firms with lower adsorption capacity. The perspective taken in this research is that ERP implementation is a valuable IT investment but requires certain organizational absorption capacities that can either enable or constrain the desired outcome of the ERP system. Thus, the ability of an organization to explore the richness of an ERP system may be hindered by factors such as technical resources, the degree of organizational fit between the ERP and organizational business functions as well as the extent of the initial ERP implementation. One of the tenets of absorption capacity theory is that organizations require a knowledge base to be able to absorb and apply new knowledge (Liang, Saraf, Hu, & Xue, 2007; Mowery, Oxley, & Silverman, 1996). Based on the theory, ERP usage is consequences of an organization's ability to recognize, identify and apply innovative applications. Therefore, absorption capacity theory can be used as the theoretical foundation for this research model, in which an organization's ability to achieve overall ERP benefit is contingent upon recognizing, exploring and using the installed ERP system.

2.2. ERP system usage

ERP system usage refers to how users employ the features of the system to perform a task (Burton-Jones & Gallivan, 2007; Nwankpa & Roumani, 2014a). System usage has been found to be a critical predictor of information system implementation success and thus for complex systems such as ERP systems, usage behavior needs to be deep and sophisticated for companies to realize inherent benefits (Schwarz & Chin, 2007; Nwankpa & Roumani, 2014a). Typically, the higher the system usage by the end-user, the better the chances of firms' achieving ERP implementation goals and objectives. Prior studies have investigated the ERP system usage. For instance, social factors, compatibility and the belief of enhancement on end-users job responsibility have been found to positively influence ERP system usage (Chang, Cheung, Cheng, & Yeung, 2008). Similarly, Nwankpa and Roumani (2014a) found that managerial commitment and user satisfaction were key predictors of ERP system usage. ERP usage problems can undercut the potential benefit expected from the system and can also undermine users' ability to understand and adopt new business processes embedded within the ERP package. Usage problems have been attributed to inadequate training, insufficient support for end-users and severity of the implementation choice (Motwani, Mirchandani, Madan, & Gunasekaran, 2002; Nicolaou, 2004; Nwankpa & Roumani, 2014a). These problems are capable of discouraging users from continually using the system or in some cases can force users to initiate workarounds that may continue indefinitely, thus limiting the systems use. This paper investigates organizational factors such as technical resources, organizational fit, extent of ERP implementation as potential factors that can positively driver ERP system usage and overcome some of these issues.

2.3. ERP system benefit

Organizations invest in ERP systems to achieve important benefits. These benefits may come in the form of improved business productivity such as shortened lead time, lower cost and efficiency communication among functional boundaries (Nwankpa & Roumani, 2014b; Watson & Schneider, 1999). Yet these expected benefits are not always visible for ERP implementing companies. An examination of US manufacturing companies found that although ERP systems were very common within the industry, the system did not lead to significant reduction in operating expenses (Marbert, Soni, & Venkataramanan, 2000). In fact, ERP benefits can vary across industries and in many cases may depend on the implementing firms (Davenport, 2000). Prior literature has attempted to understand the drivers of ERP benefits. Shang and Seddon (2002) developed five dimensions of ERP benefits namely, operational, managerial, strategic, IT infrastructure and organizational and concluded that ERP benefit was a continuous process with benefits realized at different rate in different core processes. Similarly, Gattiker and Goodhue (2005) found that over all ERP benefit was mediated by intermediate benefits and that realizing intermediate benefits was a precondition to achieving overall ERP benefit. Chou and Chang (2008) reaffirmed the role of intermediate benefits as predictor of overall ERP benefit but also found that customization and organizational mechanisms were strong predictors of intermediate ERP benefits.

2.4. Technical resources

Technical resources refer to the technical capabilities that an organization possesses. It can be viewed as the competence of an organization to develop and maintain an information system. Such technical resources are in the form of the expertise of the information system group in building and maintaining the system, the system know-how of the end-users, and the quality of hardware, network application, and software applications deployed (Jennex, 2007). Thus, technical resources are important considerations for firms making adoption decisions as firms have to establish an alignment between the available technical resources and the adopting technology or innovation. Kuan and Chau (2001) identified technical specialists, and implementation tools and techniques

as technical resources that IS manager can discretionarily manipulate to facilitate new technology use. According to Kuan and Chau (2001), these capabilities can help ensure favorable outcomes when implementing a new technology.

The current literature has considered technical resources in terms of ease of deployment and implementation of innovations. For example, Dewar and Dutton (1986) argue that the greater the technical knowledge resources in an organization, the easier it is for new ideas to be deployed understood and implemented, while Aubert, Rivard, and Patry (2004) observe that one of the main reasons for IT outsourcing is to leverage on the vendors technical resources and skills needed to develop a good system. Technical resources can undermine the agility and organizational ability to respond to a changing IT environment. According to Alter (2002), infrastructure such as human, informational, and technical resources are essential components that systems rely on to function effectively and respond to changes. Alter (2002) notes that as work system life cycle evolves, organizations response by allocating human, monetary, and technical resources to deal with such emerging issues and change the systems in line with the current trend. Typically, organizations attempt to make up for the perceived lack of technical resources by outsourcing part or all of their IT functions (Sledgianowski & Tafti, 2007).

2.5. Organizational fit of ERP system

Organizational fit of an ERP system is viewed in this article as the appropriateness of the original ERP artifact to an organization's needs in terms of data, process/task, and user interface (Hong & Kim, 2002). Organizational fit has been identified within the current literature as one of the critical factors in IS contingency research. The common theme underlying over seventy percent of these studies is the assumption that the better the fit between the IS artifact and the organization, the better the performance (Weill & Olson, 1989). For instance, Henderson and Venkatraman (1993) attributed the inability of firms to realize benefits from IT investments to a lack of alignment between the business and IT strategies. Thus, Henderson and Venkatraman (1993) developed a "strategic alignment model" to mitigate this perceived mismatch. Similarly, Marius and Ashok (1996) argued that packaged software deployment success is positively associated with the degree of vendor fit with the user organization and vice versa.

Within enterprise system research, Seddon, Calvert, and Yang (2010) identified functional fit as a key driver in organizational ability to benefit from an enterprise system. Seddon et al. (2010) suggested that functional capabilities inherent and configured within an enterprise system must be consistent with the functionality needs of the organization in order to attain efficient and effective performance. Similarly, Swan, Newell, and Robertson (1999) noted that organizational misfits of ERP occur due to conflicting interests of user organizations and ERP vendors. Hong and Kim (2002) suggested that organizational fit could be the missing piece of the puzzle in understanding and explaining IT implementation outcome variations. Yet achieving such level of organizational fit can be very challenging. The distinctive characteristics of ERP systems are that they are packaged software solutions with inherent assumptions, procedures, and business processes. These assumptions seldom match or fit tightly with those of the implementing firm's business processes. The disconnect between an organization's information processing needs and the packaged solutions embedded in an ERP system can be striking. Swan et al. (1999) observed that even when vendors attempt to develop the so called best practice solution, the unavoidable conflict of interest between user organizations, who desire a tailored solution, and ERP vendors, who prefer a generic solution applicable to the broader market, clearly undermines such an intention. In their study of ERP implementation in Singapore, Soh, Kien, and Tay-Yap (2000) noted that the organizational fit of an ERP system might be worse in Asia because the underlying process model of the ERP system is guided by European or US industry practices, which are different from Asian business practices. The study further suggested that the misfit between an organization's requirements and ERP capability may be a function of the firm, industry, and country.

2.6. Extent of ERP implementation

The extent of ERP implementation captures the degree to which an ERP system will alter the existing business processes in an organization (Karimi, Somers, & Bhattacherjee, 2009). ERP systems are modular in nature thus allowing organizations to decide on the scope and depth of the initial ERP implementation. For instance, an organization may decide whether to implement an SAP financial accounting module first before the material management module or to roll out all the modules together as one integrated deployment. The extent of ERP implementation enables firms to choose the desirable ERP deployment strategy. Depending of the firms' capacity, phased rollout, mini big-bang and big bang deployment may be selected (Marbert et al., 2000). The extent of ERP implementation has also been delineated into functional scope, organizational scope and geographic scope (Karimi et al., 2009) and the greater the functional, organization and geographic scope, the higher the extent of ERP implementation. Extant literature suggests that the extent of ERP implementation is associated with the type of benefit derivable from an ERP implementation (Markus, Axline, Petrie, & Tanis, 2000; Karimi, Somers, & Bhattacherjee, 2007). The extent of ERP implementation can create the initial conditions and the foundation technology that enables subsequent application integration (Nwankpa et al., 2013) and greater business process improvements (Karimi et al., 2007).

2.7. Managerial flexibility

Managerial flexibility denotes to managers ability to take desirable actions in response to evolving business climate and by so doing align itself with the business environment and gain business objectives (Wu, Ong, & Hsu, 2008). Managerial flexibility has become increasingly important in an environment where emerging technologies carry great risks and uncertainties. Flexibility is viewed as a dynamic capacity that enables organizations to deal with such inevitable environmental fluctuations (Zajac, Kraatz, & Bresser, 2000). Thus, managerial flexibility is particularly important for organizations operating in a volatile market or investing in an environment with emerging new technologies (Verdu & Gomez-Gras, 2009). Prior literature has examined managerial flexibility. Helo (2004) delineated managerial flexibility as consisting of two constraints time and cost. Similarly, Verdu and Gomez-Gras (2009) introduced two additional elements namely variety and intention to the initial two flexibility dimensions. Variety aspect of managerial flexibility captures the manager's ability to develop alternative measures and intention element measures how proactive the other measures developed can be applied and deployed under different conditions (Verdu & Gomez-Gras, 2009).

2.8. Knowledge integration mechanisms

Knowledge Integration Mechanisms (KIMs) are structures and processes within an organization that enables a firm to integration and apply different types of knowledge among various functional areas of business (De Luca & Atuahene-Gima, 2007). Establishing an effective mechanism for knowledge integration makes knowledge acquisition within the firm more applicable and easy to use. Organizations use KIMs as a means of creating synergy, overcoming

uncertainty and reducing knowledge disparity among subunits. Through KIMs, firms are able to increase the possibility of achieving high-quality business solutions and better cross-functional collaboration leading greater innovative performance (Tsai & Hsu, 2014). Organizations absorbing external knowledge but lacking adequate KIMs may not lay claim to the same value and benefits realized by firms with effective KIMs (Teo & Bhattacherjee, 2014).

3. Research model and hypotheses

Building on the background literature discussed above, the research model underlying this study is presented in Fig. 1. The specific hypotheses are discussed below.

3.1. Effect of technical resources on ERP system usage

As discussed earlier, technical resources are important considerations for companies making any form of technology adoption decision (Jennex, 2007). The importance of key resources in technology adoption was first articulated by Attewell (1992) who argued that successful implementation of complex systems in firms is limited by their inability to overcome some technical barriers associated with such system implementation. Recent research on technical resources, especially the work of Aubert et al. (2004), argues that inadequate technical resources can undermine a firm's ability to extract the benefits of their existing IT infrastructure. According to Aubert et al. (2004), businesses lacking adequate technical resources rely on IT outsourcing as a mean of leveraging on superior vendors' technical resources and skills. Similarly, noted scholars (e.g., Alter, 2002; Kuan & Chau, 2001) have argued that for a system to function effectively, firms need to have necessary human, informational, and technical resources. In the context of an ERP system usage, the success of ERP deployment is affected by the sort of IT-based resources possessed by an organization and how such resources are maintained and used (Bharadwaj, 2000; Luo & Strong, 2004). Karimi et al. (2007) suggest that IS resources could strengthen the relationship between building ERP capabilities and business outcomes. Because of the complexity of the ERP systems, a firm's ability to optimize the usage of the system may be obscured by the system know-how of end-users and the quality of expertise of the in-house IS group. Technical resources aid ERP system usage by helping end-users to identify new effective process routines as well as providing users with the knowledge and skills needed to effectively interact and gain optimal system performance. Similarly, managerial flexibility enables managers to select and apply these technical resources within the firm. Such managerial efforts can enhance users' perceptions of technology usefulness and importance (Amoako-Gyampah, 2007). Thus, this study expects technical resources to have a stronger effect on ERP system usage when managerial flexibility is high. Hence, the following hypotheses are predicted:

H1a. Technical resources have a positive association with ERP system usage.

H1b. The positive association between technical resources and ERP system usage is positively moderated by managerial flexibility.

3.2. Effect of organizational fit on ERP system usage

As we have discussed, the introduction of ERP requires a fit between the company and the ERP system. The greater the fit, the more efficient and effective the organizational processes will support the system and the more likely the system will assist end-users across the organization get their task and job routine accomplished (Seddon et al., 2010). Prior research on organizational fit and ERP system implementation highlights the need to achieve an alignment between ERP and the organization. For instance, Marius and Ashok (1996) argued that packaged software implementation success is positively influenced by the degree of vendor fit with the implementing organization. Similarly, Swan et al. (1999) noted that misfit inhibits a firm's ability to achieve success with their ERP implementation. Such organizational misfit according to Swan et al. (1999), occur due to conflicting interest between user organizations and vendor support. It is not surprising that an European survey found that fit between system and the company business process and procedures is the most important selection criteria for IS deployment in companies (Van Everdingen, Hillegersberg, & Waarts, 2000). In fact, Gattiker and Goodhue (2004) argued that contrary to ERP vendors' assertions, ERP system may fit some organizations better than others. According to this work, ERP fit may depend on the amount of interdependence and differentiation among the functional sub-units of an organization. Thus, understanding the extent to which the implemented ERP system can satisfy the client's business process requirements should be a key consideration in any ERP implementation decision (Hong & Kim, 2002).

In the context of ERP system usage, how well an ERP system aligns with the organization's business processes and information requirements can influence how end-users employs the system. As noted by Tsai, Chen, Hwang, and Hsu (2010), ERP system performance is result oriented and is shaped by the system quality, information quality, usage, user satisfaction, individual impact and organizational impact. Thus, a mismatch between the ERP system functionality and user organization needs may hinder overall system usage. Furthermore, managerial flexibility allows firms to appropriately align the embedded processes of an ERP system with

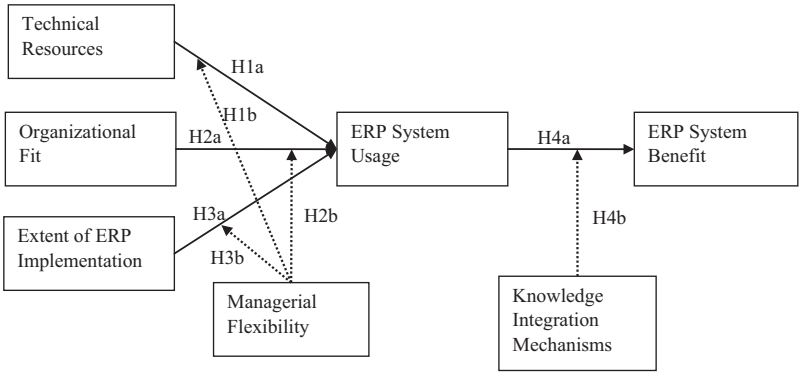

Fig. 1. Research model.

end-users task routines and job responsibilities. Thus, the following hypotheses are predicted:

H2a. Organizational fit has a positive association with ERP system usage.

H2b. The positive association between organizational fit and ERP system usage is positively moderated by managerial flexibility.

3.3. Effect of extent of ERP implementation on ERP system usage

The extent of ERP implementation has been found to have an important influence in ERP systems deployment and performance. Prior research on ERP system suggests that implementing more ERP system modules leads to stronger post-ERP performance (Hitt, Wu, & Zhou, 2002; Nicolaou, 2004). Adopting more ERP modules allow firms to improve a wide range of business processes that span through various functional areas of the business leading to improved ERP performance. Thus, the extent of ERP implementation can determine the type of benefit derivable from the ERP as well as the level of integration was inter-dependent units in the organization (Karimi et al., 2007). For example, the extent of implementation determines the business processes to be included in the deployment and these business processes will encapsulates the ERP functionalities to be implemented (Markus et al., 2000). The extent of ERP implementation has been found to be a good predictor of ease of use of add-on technologies to the ERP system (Nwankpa et al., 2013). The greater the extent of the initial ERP deployment, the more likely the implementing firm will build on the ERP platform and implement additional technologies such as Supply Chain Management (SCM) systems and web based applications (Nwankpa et al., 2013). Arguably, the greater the extent of ERP implementation, the richer the business process integration and ERP functionalities. End-users will better positioned to access and apply the ERP system functionalities to various task routines leading to increased ERP usage. Similarly, ERP divisibility enables managerial flexibility to take desirable actions to drive usage. Therefore, this study expects the extent of ERP implementation to have a stronger effect on ERP system usage when managerial flexibility is high. Thus, the following hypotheses are predicted:

H3a. Extent of ERP implementation has a positive association with ERP system usage.

H3b. The positive association between extent of ERP implementation and ERP system usage is positively moderated by managerial flexibility.

3.4. Effect of ERP system usage on ERP system benefit

ERP system usage is a measure of how users apply and use the features of an ERP system (Nwankpa & Roumani, 2014b). It has been suggested that ERP system usage is a precondition to benefit realization and that the value of an ERP lies in the effective and efficient usage of the system (Kremers & Van Dissel, 2000). ERP usage also be can viewed as a measure of how end-users accept and embrace the technology. Lin (2010) found that Information system quality and top management support impacted ERP system usage through user's perception of the usefulness and satisfaction derivable from their ERP system. Prior studies have explored ERP system usage. For instance, Nwankpa and Roumani (2014b) found that organizational trust dimensions had positive effects on ERP system usage while Motwani et al. (2002) found that inefficient change management and the severity of implementation strategy affected ERP system usage. In the context of ERP system benefit, anecdotal evident suggests that ERP usage is positively associated with overall ERP benefit. Deloitte (1999) argued that the process of achieving ERP additional benefit is a function the depth of usage at the post implementation phase. Similarly, Nolan and Norton Institute (2000) suggested that the level of maturity measured by how well user embraced and assimilated the ERP over time influenced overall ERP benefit. In sum, this study argues that ERP system usage will influence ERP system benefit realized as greater use will lead to improved business performance. KIMs enable the integration and assimilation of knowledge among various functional areas (De Luca & Atuahene-Gima, 2007). Wu and Wang (2007) note that users' knowledge and involvement are important to overall ERP successes. Thus, as ERP implementing firms deploy procedures such as user training to inspire greater usage, organizations with more efficient KIMs can leverage to it to overcome knowledge gaps and uncertainties associated with users leading to improve ERP usage. Hence, the following hypotheses are predicted.

H4a. ERP system usage has a positive association with ERP system benefit.

H4b. The positive association between ERP system usage and ERP system benefit is positively moderated by knowledge integration mechanisms.

3.5. Control variables

IT benefit and assimilation processes are subject to various other organizational influences (Fichman, 2001). To curtail the confounding effect of spurious correlations, this study included firm size and ERP system duration as control variables. Firm size is often an important control variable as it is found to determine firm performance and innovativeness (Kim & Lee, 2010; Kimberly, 1976). Larger firms can benefit from economies of scale arising from human capital and resource capacity while duration, measured by the length of time since the firm implemented the ERP system can influence performance.

4. Research methodology

To understand the factors influencing ERP system usage and benefit, an empirical study was conducted.

4.1. Sample and study procedures

This study required inputs from end-users and data were collected from 157 users across United States companies that implemented ERP packages at least 2 years prior to this study. The companies were identified from a various source ranging from list of ERP vendors, periodicals and IT groups and organizations. First, each potential respondent was identified and contacted with a request to participate in the study in exchange for the promise of a report describing findings of the study. A web-based survey instrument was developed and administered for the empirical analysis of the proposed hypotheses, an approach that has been noted for its speed (Dillman, 2007), low cost (Weible & Wallace, 1998), and improved response quality (Paolo, Bonaminio, Gibson, Patridge, & Kallail, 2000).

After collecting information about each participant, an email containing a URL link to the web survey was sent to them. Two reminders to participate were subsequently sent, and the survey closed 30 days after the initial invitation was e-mailed. Out of

the 750 potential respondents, 63 e-mails were returned as undeliverable for various reasons ranging from recipient out of office, user name not valid, to recipient no longer with the firm. Of the remaining 687 contacted, 179 responded within our deadline, for an effective response rate of 26.05%. After eliminating incomplete responses, the final number of usable responses was 157 resulting in a usable responses rate of 22.85%. These respondents represented major industries including manufacturing (20.6%), construction (16.7%), service (28.7%), energy (10.1%), financial (6.1%), telecommunication service (7.3%) information technology (6.3%) and others (4.2%). In terms of firm size, 41% of responding firms reported a market capitalization between $500 million and $999 million, 21% between $1 billion and $4.9 billion, 15% between $5 billion or more and 23% with a market capitalization less than $500 million. These data indicate that the sample is well represented in terms of industry and size.

4.2. Measurement

The measures were designed based on extensive review of related literature. The questionnaire was structured in such a way to ensure ease of understanding and to generate valid results. In developing the measures, whenever possible, this study adapted existing measures that had been used in previous literature. Hatch (2002) notes that existing studies can provide the foundation needed to design an instrument as it affords the ability to recognize gaps in the literature. However, modifications were made on these existing measures to fit the context of this study. The preliminary instrument was administrated to graduate students from a public university. They were asked to review and provide feedback on the questions. The group was asked to examine if the items were indeed representing the construct under study as well as to comment on the wording of the measurement items. Based on their initial comments, some modifications were made on the instrument to enhance clarity. Furthermore, a pilot test was undertaken to further refine the instrument. A version of the questionnaire was administered to a random sample of 100 ERP system end-users. Respondents were instructed to indicate their level of agreement with a statement using a 7-point Likert Scale. According to Alreck and Settle (1995), pilot testing is a brief preliminary survey using a small convenient sample. The aim of the pilot testing is to identify and eliminate problems inherent with the developed instrument before collecting the data from the target population. Appendix A shows the relevant literature and the specific items for all the constructs. All items were assessed using a seven-point Likert-type scale.

5. Analysis and results

The analysis and empirical validation of the hypotheses were done with partial least square (PLS) analysis. SmartPLS 2.0 (Ringle, Wende, & Will, 2005) software was used for the analysis. PLS is appropriate for complex models involving latent variables. Moreover, PLS does not require any assumptions of multivariate normality (Chin, Marcolin, & Newsted, 2003) and it works well with small to medium data points (Chin, 1998). SmartPLS 2.0 performs bootstrapping analysis to assess the statistical significance of the loading and of the path coefficients (Ringle et al., 2005). Consistent with prior research using PLS models, the analysis of the research model was done in two stages (e.g., Chin, 2001; Gefen & Straub, 2005; Hulland, 1999). 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, p. 198).

5.1. Assessment of potential response bias and common method bias

To test for the potential response bias this study followed the wave analysis recommended by Armstrong and Overton (1977). Respondents were split into two groups based on the time the response was received. Usually, late respondents' answers tend to be consistent with the non-respondents and are different from early respondents (Armstrong & Overton, 1977). A *t*-test conducted to compare the means of these two identified groups did not find any significant difference in the mean responses between late respondents and the rest of the respondents. Because dropouts are typical in web based survey and may be a potential threat to data quality, this study examined whether respondents who completed the survey were different from those who dropped out.

Common method bias was a potential issue because each survey was completed by a single respondent. Following Podsakoff and Organ (1986) recommendation, a Harman's one-factor test was conducted on each construct. The result reveals that the most covariance explained by one factor was 31.51 percent which suggest that common method bias was not likely an issue. Furthermore, this study applied Liang et al. (2007) procedure to test common method bias in PLS. The result also indicated that method loadings were insignificant and that indicators variables were greater than their method variable leading to a conclusion that common method bias was not a serious threat to this investigation.

5.2. Measurement model and construct validity

Confirmatory factor analysis (CFA) was conducted for all of the latent constructs (see Table 1). All item loadings were greater than .60 as recommended by Hair, Anderson, Tatham, and Black (1998). Thus, the items are representative of their respective constructs. Reliability, convergent validity, and discriminant validity of the measurement models were also assessed. Acceptable reliability

Table 1
Item loading and cross-loadings.

	TR	OF	EEI	MF	ESU	KIM	ESB
TR1	0.921	0.511	0.432	0.419	0.519	0.501	0.426
TR2	0.911	0.487	0.417	0.466	0.543	0.478	0.407
TR3	0.902	0.477	0.452	0.476	0.531	0.498	0.399
TR4	0.917	0.431	0.474	0.493	0.498	0.514	0.433
OF1	0.444	0.937	0.447	0.498	0.505	0.413	0.319
OF2	0.497	0.916	0.481	0.491	0.485	0.407	0.397
OF3	0.492	0.934	0.419	0.483	0.491	0.409	0.391
OF4	0.459	0.951	0.495	0.477	0.463	0.491	0.409
EEI1	0.485	0.412	0.901	0.401	0.387	0.413	0.394
EEI2	0.443	0.431	0.899	0.462	0.401	0.367	0.391
EEI3	0.452	0.447	0.932	0.473	0.398	0.397	0.375
MF1	0.413	0.457	0.412	0.905	0.429	0.429	0.398
MF2	0.432	0.471	0.435	0.932	0.431	0.466	0.432
MF3	0.455	0.439	0.456	0.907	0.434	0.483	0.429
MF4	0.432	0.449	0.461	0.947	0.487	0.431	0.421
ESU1	0.429	0.396	0.411	0.429	0.937	0.417	0.419
ESU2	0.432	0.378	0.432	0.438	0.919	0.451	0.424
ESU3	0.442	0.409	0.438	0.417	0.925	0.449	0.467
KIM1	0.417	0.389	0.384	0.412	0.398	0.934	0.438
KIM2	0.397	0.416	0.502	0.431	0.391	0.921	0.402
KIM3	0.419	0.395	0.433	0.444	0.431	0.909	0.429
KIM4	0.459	0.404	0.421	0.394	0.392	0.902	0.458
KIM5	0.472	0.401	0.453	0.502	0.422	0.931	0.424
KIM6	0.439	0.396	0.429	0.443	0.422	0.938	0.426
KIM7	0.458	0.439	0.416	0.418	0.409	0.899	0.438
ESB1	0.379	0.411	0.417	0.467	0.452	0.433	0.938
ESB2	0.412	0.428	0.429	0.398	0.421	0.442	0.942
ESB3	0.399	0.409	0.442	0.414	0.415	0.427	0.917

TR: Technical Resources, OF: Organizational Fit, EEI: Extent of ERP Implementation, MF: Managerial Flexibility, ESU: ERP System Usage, ESB: ERP System Benefit, KIM: Knowledge Integration Mechanisms.

or internal consistency is attained when the Cronbach's alpha and composite reliability are greater than 0.70 (Nunnally, 1978). As shown in Table 2, the composite reliabilities were all above 0.70; thus all measures have an adequate level of reliability.

Convergent validity is achieved when scores of items used to measure a construct correlate with or are related to scores of other items that are designed to measure the same construct (Campbell & Fiske, 1959). Convergent validity can be assessed by measuring the reliability of survey items, composite reliability of constructs, average variance extracted (AVE) and factor analysis (Komiak & Benbasat, 2006). As shown in Table 2, all factor loadings were greater than 0.70 and the AVE of every latent variable in the research model was greater than 0.70 and they all loaded highly on their own latent variable.

Discriminant validity examines the extent to which a measure correlates with measures of constructs that are different from the construct the measure is intended to assess (Barclay, Higgins, & Thompson, 1995). This would imply that the construct does not share much variance with other constructs, but rather with its own measures. Discriminant validity of the measure is acceptable if the AVE of each construct is greater than the variance among all constructs (Chin, 1998) or if the AVE for each construct is greater than 0.50 and the square root of the AVE for a construct is greater than the correlation of that construct with other constructs (Fornell & Larcker, 1981). This is normally demonstrated by showing that the square root of an AVE is greater than the correlations among the construct and all other constructs in the model. The correlation matrix among all constructs is presented in Table 2. As shown in the table, the square root of an AVE of each construct is greater than the correlations between the construct and all other constructs. Thus, the measurements demonstrate satisfactory levels of discriminant validity.

5.3. Structural model testing

In PLS analysis examining the structural paths and the *R*-square scores of the endogenous variables assesses the explanatory power of the structural model. The results of the PLS analyses are illustrated and summarized in Fig. 2. Most of the hypotheses were supported as expected. As indicated in Fig. 2, the influence of technical resources, organizational fit, and extent of ERP implementation were all significant and accounted for 41.3 percent variance of ERP system usage. Thus providing support for H1a ($\beta = 0.211$, $p < 0.01$), H2a ($\beta = 0.272$, $p < 0.01$) H3a ($\beta = 219$, $p < 0.01$). This implies that ERP user organizations can improve their ERP system usage by making sure that they have adequate technical resources and capabilities, by ensuring that an effective alignment is established between the ERP software package and the company and by the extent of the initial ERP implementation. Further, the influence of technical resources and organizational fit on ERP system usage is positively moderated by the availability of managerial flexibility. Contrary to the proposed hypothesis, managerial flexibility was not found to be a positive moderator of the effect of extent of ERP implementation and ERP system usage. Hypothesis 4a on ERP system usage effect on ERP system benefit is supported ($\beta = 0.244$, $p < 0.01$) with ERP system usage accounting for 27 percent of the variance. Also, Hypothesis 4b on the positive moderating effect of knowledge integration mechanisms on the association of ERP system usage and ERP system benefit is supported.

6. Discussion

This study provides valuable insight into the usage and benefit of ERP systems as a way of explaining variances in outcome associated with ERP implementation and use. Consistent with the hypotheses, the findings indicate that technical resources have a significant positive effect on ERP system usage. This result reflects some of the prior findings within the literature. In fact, Aubert et al. (2004) argue that inadequate technical resources can undercut the use and benefits from their technology infrastructure. Because of the complex nature of ERP systems, having the appropriate technical resources allows user organizations to optimize system assimilation and use. As Karimi et al. (2007) suggest, businesses with such resources will be able to strengthen the relationship between ERP systems and desirable business outcomes. However, the importance of technical resources as a predictor of ERP system usage increases with the availability of managerial flexibility.

The results of this study also indicate that organizational fit is an important enabler of ERP system usage. This finding is consistent with recent research, which argues that greater fit between a system and the organizational processes that the system supports will result in higher efficiency and effectiveness (Seddon et al., 2010). Indeed, having organizational fit with the ERP system can help streamline end-users experience and can help organizations to achieve desired results in terms of data, processes, and user interface. It is necessary to consider how existing user organizations processes and requirements fit into the process, data, and interface of an ERP package, otherwise effort to realize the optimal performance of an ERP system may be futile. In addition, managerial flexibility was found to be a moderator of the relationship between organizational fit and ERP system usage. Thus, organizations with managerial flexibility are able to apply interventions and create conditions that will foster greater fit, leading to increased ERP system usage.

Consistent with the hypothesis, the results indicate that the extent of ERP implementation has a positive effect on ERP system usage. This result was anticipated because the extent of ERP implementation allows wider range of business process integration and allows end-users access to a more ERP functionalities. This finding is consistent with prior literature that suggests that the extent of ERP implementation influences ERP performance (Karimi et al., 2007; Markus et al., 2000). Contrary to the proposed hypothesis, managerial flexibility did not moderate the relationship between extent of ERP implementation and ERP system usage.

Table 2
Descriptive statistics, validity and reliability.

Constructs	Mean	SD	α	CR	AVE	ESB	TR	OF	EEI	MF	KIM	ESU
ESB	4.78	1.42	0.94	0.96	0.90	**0.94**						
TR	4.61	1.06	0.96	0.97	0.91	0.23	**0.95**					
OF	4.60	1.18	0.93	0.95	0.89	0.45	0.39	**0.94**				
EEI	5.45	1.27	0.93	0.95	0.89	0.43	0.51	0.42	**0.94**			
MF	4.74	1.04	0.92	0.94	0.88	0.19	0.08	−0.09	−0.11	**0.93**		
KIM	5.82	1.17	0.94	0.96	0.91	0.32	0.49	0.29	0.41	0.39	**0.95**	
ESU	5.19	1.12	0.95	0.97	0.91	0.51	0.39	0.49	0.48	0.55	0.52	**0.95**

Square roots of AVE are shown in bold alone the diagonal.

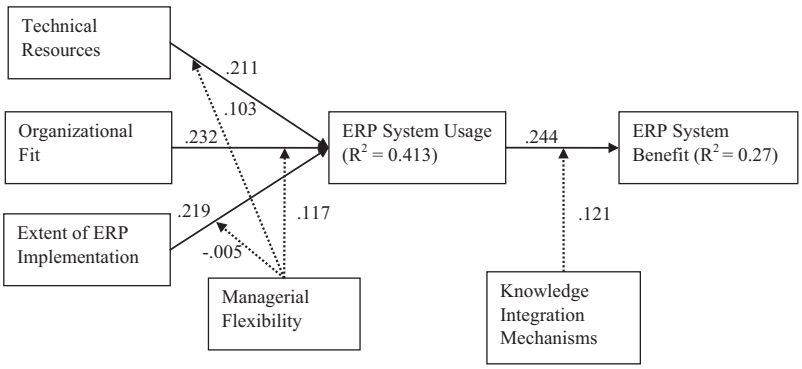

Fig. 2. Research model with results.

7. Theoretical and practical implications

This study makes key contributions to theory and practice related to ERP system usage and benefit. As pointed out earlier, although organizations continue to invest in ERP systems, such investments have not always yielded desired results. This study attempted to unravel that puzzle by examining the antecedents of ERP system usage. Insight was provided as to the specific interplay among organizational factors namely – technical resources, organizational fit and extent of ERP implementation and ERP system usage as well as ERP benefit. The empirical results hold important implications for future research that seeks to reconcile variance outcome of ERP usage and benefit. The study provides answers to the important questions regarding the influence of organizational fit, technical resources and extent of ERP implementation affect ERP system usage. These results provide managerial insights on specific practices and interventions that enable ERP system usage. The key antecedents of ERP system usage revealed in this study can provide a theoretical lens for further understanding of how firms can stabilize and use their ERP systems efficiently and effectively. More specifically, the antecedents revealed in this study can be integrated into a number of different models that seek to offer more expansive view and understanding of ERP system usage and benefits.

This study should be of practical importance to managers and executives who grapple with the challenges of selecting the appropriate implementation strategy. For managers and executives, the study reveals that the key to inspiring adequate usage of their ERP technology may reside in the depth and extent of the initial ERP implementation. Thus, prior to ERP deployment, it may be more appropriate for organizations to consider how well the ERP initial deployment captures critical organization's business processes, data requirements and user interface, rather than solely relying on ERP vendors' claims that ERP systems are guaranteed to provide "best practice" solutions to an organization's information processing needs.

8. Limitations

Although this study makes a number of contributions, like all other research studies, it has some limitations. First, the study emphasized a limited number of variables that may affect ERP system usage. While these factors play a critical role in influencing ERP system usage, other factors such as the ERP vendor support and the financial resources of the firm may affect ERP system usage. It is important not to delimit ERP system usage to organizational context while ignoring the social context in which the system is used. Second, while this study considers organizational fit, it does not consider the level of fit that may affect the success of ERP system usage. Such a design may not adequately capture the interaction between organizational fit and the level of customization required to achieve it. Finally, although the study found causal relationships between many of the key constructs, it is important to emphasize that the cross-sectional data-collection approach used in this study shows only correlation. An in-depth process-oriented research design may help us to realize how ERP system usage changes at different stages in the implementation process. In spite of the aforementioned limitation, this study has important implications for both research and practice.

9. Conclusions

Achieving the desired ERP system usage among end-users is not automatic after successfully implementation the ERP system and shifting to the post-implementation stage. In order to improve ERP usage and assimilation, this study developed and tested a model that identifies key enablers and antecedents of ERP system usage. The findings supported the proposed hypotheses. These findings contribute to a deeper understanding of ERP system benefit and provide a foundation for future investigations and insights for organizations faced with the challenge of maximizing the inherent values of their ERP systems. The findings further our knowledge on how organizational factor can be applied to advance ERP system usage in particular and gain expected ERP system benefit in general. There is no doubt that ERP systems are cutting-edge technologies with superior embedded benefits. To realize it however, companies need to foster usage among end-users.

Appendix A. Measurement items

Technical resources

TR1: Our firm has the IT personnel or support group necessary to support our ERP system.
TR2: Our firm has the maintenance team necessary to support our ERP system.
TR3: Our firm has the user competency necessary to assimilate our ERP system.
TR4: Our firm has the IT experience necessary to sustain our ERP system.

Organizational fit

OF1: The functionality built in ERP meets the needs required from our company (Wang, Chia-Lin Lin, Jiang, & Klein, 2007).
OF2: The processes flow built in ERP corresponds to flow of our company (Wang et al., 2007).
OF3: The form and format data items of the ERP correspond to those of the documents used in our company (Hong & Kim, 2002).

OF4: User interface of the ERP is well designed to the business needs of our company (Hong & Kim, 2002).

Extent of ERP implementation

EE1: Functional scope of implementation of your selected ERP System: Accounting/Finance, Manufacturing, Planning/Scheduling, Human Resources, Sales/Distribution, Logistics/Inventory Control, Other (please specify) (based on Karimi et al., 2007).

EE2: Scope of implementation of your selected ERP: Department/Division, Multiple departments/divisions, Entire company, Multiple companies, Other (please specify) (based on Karimi et al., 2007).

EE3: Geographical extent of implementation: Single site, Multiple sites, National, Global (based on Karimi et al., 2007).

Managerial flexibility

MF1: Our ERP system post-implementation processes can be changed.

MF2: The decision to apply our ERP system across subunits can be altered.

MF3: The decision to apply our ERP system across functional units can be delayed.

MF4: Our ERP system post-implementation processes can be expanded or contracted.

ERP system usage

ESU1: I use the ERP system installed in my organization very intensively to support my Schwarz (2003).

ESU2: I use the ERP system installing in my organization very frequency to support my work Schwarz (2003).

ESU3: Overall, I use the ERP system a lot Chang et al. (2008).

Knowledge integration mechanisms

To what extent do you agree with these statements – In our company,

KIM1: Whenever we get new ideas in our work we communicate it to all team members (based on Teo & Bhattacherjee, 2014).

KIM2: We document the things we learn on the job for others to use (based on Teo & Bhattacherjee, 2014).

KIM3: We spend time during our meetings to share expertise with our colleagues (based on Teo & Bhattacherjee, 2014).

KIM4: We frequently attend vendor and industry conferences to learn about best practices that we could implement in our firm (based on Teo & Bhattacherjee, 2014).

KIM5: We have in-house meetings to encourage knowledge dissemination (based on Teo & Bhattacherjee, 2014).

KIM6: We are open to employees experimenting with new ideas and technologies (based on Teo & Bhattacherjee, 2014).

KIM7: We provide the resources to explore new ideas and innovations (based on Teo & Bhattacherjee, 2014).

ERP system benefit

ESB1: In terms of ERP's business impacts on the organization, the ERP system has been a success (based on Chou & Chang, 2008).

ESB2: ERP has seriously improved the organization's overall business performance (based on Chou & Chang, 2008).

ESB3: ERP has had a significant positive effect on this organization (based on Chou & Chang, 2008).

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