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Princely Ifinedo

*Cape Breton University*, princely\_ifinedo@cbu.ca

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# AN EXAMINATION OF INFORMATION TECHNOLOGY ASSETS AND RESOURCES AS ANTECEDENT FACTORS TO ERP SYSTEM SUCCESS

*Complete Research*

Princely, Ifinedo, Cape Breton University, Sydney, NS, Canada, princely\_ifinedo@cbu.ca

## **Abstract**

*Organizations adopt enterprise resource planning (ERP) systems to improve information exchange across the enterprise. Research continues to show that adopting organizations do not achieve the intended objectives with the acquisition of such packages. Studies are needed to understand factors – contingent or otherwise – that may help increase knowledge in the area. This study was designed to contribute to that discourse. We examined the effects of select few information technology (IT) assets and resources, i.e. IT budgets, organizational actors' IT skills/knowledge, IT function's value, external expertise, and so forth, on ERP success. While such antecedent factors matter in the discourse, research combining them in order to assess their effects on ERP success is rare. Using a cross-sectional field survey, we collected data from 165 firms in three Nordic countries. Data analysis was performed using the partial least squares (PLS) technique. Statistical support was found for nine (9) out of the fifteen (15) hypotheses formulated. External expertise and organizational IT skills/knowledge were found to have significant, positive effects on ERP success, as did satisfaction with legacy systems, a result that contradicts conventional wisdom in the area. Our data did not indicate that IT function's value, IT department size and budgets have significant effects on ERP success.*

*Keywords: IT assets, IT resources, Enterprise resource planning (ERP), IS success evaluation, Survey.*

# 1 Introduction

Business packages such as enterprise resource planning (ERP) systems that pioneered a process-oriented business management paradigm surfaced in 1990s (Davenport, 1998; Ram et al., 2013). Essentially, ERP systems permit the sharing of common data resources in a real-time environment (Klaus et al., 2000). Organizations around the world continue to embrace such systems. A recent report shows that “the worldwide ERP software market grew 3.8% from \$24.4 [billion] in 2012 to \$25.4 [billion] in 2013” (Forbes-Tech, 2014). Academic literature and commentaries from related trade press on the positive impacts of ERP systems have been confusing (META Group, 1999; Maguire et al., 2010; Zhu et al., 2010; Ram and Corkindale, 2014; Garg and Agarwal, 2014). While positive impacts of ERP initiatives to adopting organizations have been noted (Hunton et al., 2003; Nicolaou, 2004), others suggested that ERP post-implementation success is low, and in fact, several adopting firms do not achieve the intended goals with the acquisitions of such applications (e.g. Wang et al., 2008; Zhu et al., 2010; Maguire et al., 2010). More empirical studies are needed to increase knowledge of factors that can enhance the success of such systems in adopting organizations. This is the main motivation of this study.

Previous research has investigated the relationships between antecedents such as top management support and commitment (Liang et al., 2007), firm size (Hunton et al., 2003), organizational culture (Jones et al., 2006; Ifinedo, 2007), organizational structure (Ifinedo, 2007; Morton and Hu, 2008), and organizational citizenship behaviors (Yoon, 2009) in relation to ERP success. Others have also examined the effects of relevant contingent factors including external expertise (Wang and Chen, 2006; Ko et al., 2005), satisfaction with legacy information technology (IT) (Ifinedo and Nahar, 2009), IT function’s value and internal IT knowledge/skills of organizational actors (i.e. IT personnel and business employees) (Willcocks and Sykes, 2000; Somers and Nelson, 2003; Amoako-Gyampah, 2007; Wu and Wang, 2007; Wang et al., 2008; Ifinedo, 2011a) on ERP success. Even though past studies have signified the relevance of IT antecedents to ERP success (Ifinedo, 2011a; 2011b), more knowledge is needed to engender understanding in the area. No previous research has combined some of the foregoing IT-related antecedent factors in one study as we intend to do. With respect to theory development, our findings and conclusion add to the body of work discussing ERP success assessment in the literature. Accordingly, our findings and conclusion contribute to the discourse in this area of study.

What practical implications does this study offer? ERP practitioners may benefit from knowing which IT contingency factors to pay more attention to (at least, in the context of the ones considered herein). Practitioners may also want to know the answers to the following questions: Would ERP system success be higher if organizational actors possess adequate IT skills/knowledge? Which is more important for higher ERP success: is it quality external expertise or the value placed on the IT function in an organization? Is satisfaction with old (legacy) IT a barrier to ERP success? Answers to some of the foregoing questions will be useful for management. In addressing the issues, our study draws from two theoretical frameworks, i.e. the contingency theory (CT) (Lawrence and Lorsch, 1967) and DeLone and McLean’s (1992) information systems (IS) success evaluation model.

## 2 Background Information

### 2.1 Theoretical foundations

We used the contingency theory (CT) (Lawrence and Lorsch, 1967) to provide a theoretical foundation for our research. CT posits that organizational effectiveness (such as ERP success in this instance) can be achieved by matching contingency factors to relevant antecedents (Donaldson, 2001). In the context of ERP success evaluation, favorable levels of relevant contingency factors are expected to generate desired outcomes. Prior studies have shown that a positive relationship exists between

organizational characteristics and ERP effectiveness (e.g. Zviran et al., 2005; Petter et al., 2008; Wang and Chen, 2006; Wang et al., 2008; Zhu et al., 2010).

## 2.2 ERP system success

In this study, the notion of ERP system success draws from the work of DeLone and McLean (D&M) (1992) and Gable et al. (2008). In these studies, ERP success refers to the employment of such systems to realize organizational goals; it does not comprise the technical installations' success (i.e. ERP implementation success) (Somers and Nelson, 2003; Amoako-Gyampah, 2007; Schniederjans and Yadav, 2013) that covers such indicators as project management metrics, time estimate, and so forth.

Using multi-stage data collection and relevant statistical analysis, Gable et al. (2008) eliminated the dimensions of "use" and "user satisfaction" in the original D&M success model. Other ERP researchers (e.g. Ifinedo et al., 2010; Ifinedo, 2011a; Chang et al., 2012; Bavarsad et al., 2013) have conceptualized ERP success in a similar fashion. That said, the ERP success constructs or dimensions considered in this study are: system quality (SYSQ), information quality (INFQ), individual impact (INDI), and organizational impact (ORGI). The descriptions of these terms are provided in Table 1.

In tune with Gable et al.'s conceptualization, we accept that ERP system success is contingent upon organizational members grasping both the technical (system) and semantic (information) qualities of the system and also achieving relevant impacts at the individual and organizational levels. Notably, technical or system quality deals with characteristics of the system with respect to accuracy, reliability, efficiency, and so forth. Semantic or information quality deals with characteristics of the system regarding timeliness, availability, and understandability, and so forth.

Dimension	Description/meaning
System quality	This refers to the performance characteristics of the ERP system with regard to ease of use, accuracy, reliability, efficiency, and so forth.
Information quality	This refers to the characteristics of the output provided by the ERP system with respect to timeliness, relevance, availability, and understandability, and so forth.
Individual impact	This is concerned with the effect of ERP on the individual, often assessed through increased individual's productivity, improved decision-making capability, and so forth.
Organizational impact	These are the benefits that the organization gets from its ERP system, often measured by the extent to which customer service, decision-making processes, and so forth have been enhanced.

Table 1. The description of ERP success dimensions or constructs

## 2.3 IT antecedents: resources and assets

Resource is defined as "a source of supply or support" or "a supply of something (such as money) that someone has and can use when it is needed" (Merriam-Webster Dictionary Online, 2014). Accordingly, IT resources refer to a source of supply and support (i.e. budgets and IT department's size) and external expertise that an adopting organization can utilize for their ERP initiatives. Ein-Dor and Segev (1978, p. 1070) posit that "budgeting of sufficient resources increases the likelihood of [IT] success." Larger firms tend to have specialized IT departments, usually with a sizeable number of workers whereas smaller firms due to resource poverty problems lack such (Cragg and King, 1993; Laukkanen et al., 2005). External sources of expertise has long been considered a critical ingredient required for the success of complex systems such as ERP (Markus and Tanis, 2000; Ko et al., 2005; Wang and Chen, 2006; Wu and Wang, 2007).

Lee and Lee (2004) described IT assets as infrastructural support that may include highly competent human IT assets and relationships between IT and business. Namely, the relationships between IT and business may include the value placed on the IT function by organizational members. Business

employees possessing adequate general computer knowledge/skills can be beneficial to their organizations as ERP packages are being adopted (Wu and Wang, 2007; Amoako-Gyampah, 2007; Ifinedo, 2011a; 2011b). Similarly, skills and knowledge of internal IT staff is critically important to the long-term success of ERP for adopting organizations (Markus and Tanis, 2000; Willcocks and Sykes, 2000; Lee and Lee, 2004; Somers and Nelson, 2003; Ram et al., 2013). To some extent, success with ERP acquisitions rests on the value placed on the IT function or department for adopting organizations (Willcocks and Sykes, 2000; Wang and Chen, 2006). Aging legacy systems' replacement is often mentioned as one of the main reasons for adopting ERP systems (Davenport, 1998; Mabert et al., 2003). However, past research reported that in some instances, legacy IT do not get replaced during ERP acquisitions because such systems are viewed as assets to the adopting organizations (Themistocleous and Irani, 2001; Ng and Tan, 2004).

## 2.4 Research scope and setting

It is worth mentioning that our focus on ERP systems is at a generic level. Notably, emphasis is placed on ERP basic functionality; we did not differentiate between top brands and mid-market ERP products. In fact, some studies (Mabert et al., 2003; Fisher et al., 2004) found no marked differences between differing ERP types. The inclusion of all ERP types augurs well for the generalizability of our findings.

We collected data in three (3), technologically advanced, Nordic countries, i.e. Norway, Finland and Sweden. Firms in the region started adopting ERP systems in the late 1990s (van Everdingen et al., 2000); as such, we believe that participants from firms in the region would be able to provide useful information for our study. We focused only on private organizations in the selected countries; others elsewhere have presented findings from public organizations (Gable et al., 2008). The literature benefits when viewpoints and information are sourced from diversified contexts. Given that the countries considered in our study share similar cultural values (Hofstede, 2003), we are assured of the homogenous nature of our sample on a major differentiator i.e. national cultural values. Moreover, some researchers suggested that IS success evaluations and ERP processes implementation vary by cultural contexts (Soh et al., 2000; Agourram, 2009).

## 3 Research Model and Hypotheses

Figure 1 illustrates the research model and hypothesized paths. The research model suggests that IT antecedent factors positively impacts ERP success quality dimensions i.e. system and information qualities. It is established that quality factors lead to improvements in organizational performance, effectiveness, or success (Juran, 1988). In that regard and consistent with D&M's IS success schema, the positive relationships between ERP quality and impact dimensions are highlighted. The hypotheses statements are presented below.

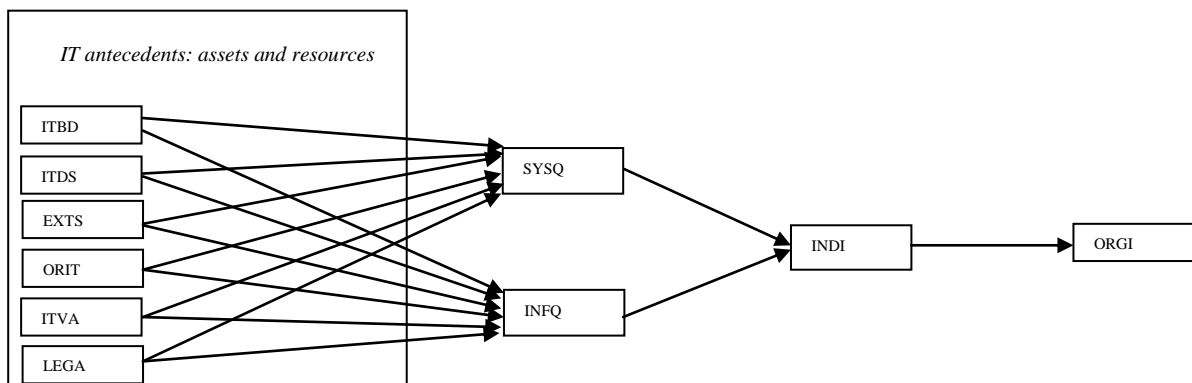


Figure 1. The research model

IT budgets (ITBD): Availability of financial resources bode well for the success of IT in organizations (Ein-Dor and Segev, 1978). This is more acute for complex systems such as ERP that require a flow of large amounts of financial resources to maintain them (Davenport, 1998; Hunton et al., 2003). It is reasonable to expect that both the technical and semantic qualities of ERP would be high where sufficient funds have been allocated to the acquisition of ERP systems that are high in such capabilities (Mabert et al., 2003; Fisher et al., 2004). The foregoing statement is predicated on the rational thinking that constrained resources might have caused less resourced organizations to adopt packages of lower quality. All things being equal, in contexts where funds are available and reasonably allocated to IT matters, the evaluations of ERP qualities would be high and accordingly be low where resource allocation might have been limited (Ein-Dor and Segev, 1978; Cragg and King, 1993). Hence:

H1a: IT budgets would have a positive effect on the assessment of ERP system quality

H1b: IT budgets would have a positive effect on the assessment of ERP information quality

IT department's size (ITDS): Evidence points to the fact that large firms tend to have specialized IT departments, usually with a sizeable number of staff. Small firms perhaps due to resource poverty problems do not have such (Cragg and King, 1993; Laukkanen et al., 2005). IT projects success increases in larger organizations because of the availability of such resources (Ein-Dor and Segev, 1978; Ifinedo, 2007). It is reasonable to expect that an organization with a large IT department may not be too stretched in assisting organizational members learn or grasp the technical and semantic qualities of acquired ERP systems. *Ceteris paribus*, we expect that ERP qualities' evaluations would be more favorable where such resources are in abundance as opposed to where such is limited or lacking. Hence:

H2a: IT department's size would have a positive effect on the assessment of ERP system quality

H2b: IT department's size would have a positive effect on the assessment of ERP information quality

External source of expertise (EXTS): This particular factor is considered to be an important for the success of ERP initiatives (Ko et al., 2005; Wang and Chen, 2006). The benefits that users derive from ERP systems tend to be higher where external expertise is dependable, resourceful, and committed (Ko et al., 2005, Wang and Chen, 2006; Wang et al., 2008). It is suggested that ERP adopting organizations (and their members) experience higher levels of success with their packages when knowledgeable external expertise are engaged (Markus and Tanis, 2000; Wang and Chen, 2006). The quality attributes of ERP packages are better appreciated where the sources of expertise ERP knowledge are perceived to be reliable, committed, and knowledgeable (Gefen and Ridings; 2002; Ko et al., 2005). Hence:

H3a: External expertise would have a positive effect on the assessment of ERP system quality

H3b: External expertise would have a positive effect on the assessment of ERP information quality

Organizational IT skills/knowledge (ORIT): Lazar et al. (2006) found that lack of computer knowledge lead to frustrations with the utilization of IT. Business employees with a good knowledge of basic computers or IT skills/knowledge would be useful in ensuring the success of IT in their organizations (Torkzadeh and Lee, 2003; Lazar et al., 2006; Amoako-Gyampah, 2007; Peslak and Davis 2009; Ram et al., 2013). Such basic knowledge might enable them to comprehend the technical and semantic qualities of IT packages. Lee and Lee (2004) and Yoon et al. (1995) suggested that internal IT expertise are also critically important to adopting organizations as knowledge is being transferred to organizational members from external providers. Collectively, internal IT

skills/knowledge of both organizational actors augurs well for appreciating ERP qualities (Markus and Tanis, 2000; Somers and Nelson, 2003; Ko et al., 2005). Hence:

H4a: Organizational IT skills/knowledge would have a positive effect on the assessment of ERP system quality

H4b: Organizational IT skills/knowledge would have a positive effect on the assessment of ERP information quality

IT function's value (ITVA): IT and other technological products positively transform the business environment (Davenport, 1998; Klaus et al., 2000; Hunton et al., 2003). Such positive transformations are quite distinct where an organization's internal IT staff is knowledgeable of IT capabilities vis-à-vis organizational objectives (Davenport, 1998; Ko et al., 2005). Studies found that where the IT function or department is valued, operational success resulting from IT use tends to be high (Wang and Chen, 2006). Willcocks and Sykes (2000) suggested that ERP acquisitions tend to be more successful where IT departments are rated highly and valued. This is because internal IT staff are able to offer assistance to end users by helping them grasp the semantic and technical qualities of acquired systems (Ko et al., 2005; Wang and Chen, 2006; Wu and Wang, 2007). Hence:

H5a: IT functions' value would have a positive effect on the assessment of ERP system quality

H5b: IT functions' value would have a positive effect on the assessment of ERP information quality

Satisfaction with old (legacy) systems (LEGA): The overriding belief is that ERP systems are adopted to replace aging legacy IT (Davenport, 1998; 2000; Mabert et al., 2003). However, organizations do not always replace aging legacy IT when ERP and similar systems are adopted (Themistocleous and Irani, 2001; Ng and Tan, 2004). Indeed, practitioners caution against the notion indicating that other types of systems (legacy and in-house) cannot be used with ERP (A.T.Kearney, 2014). Chau and Tam (1997, p.12) commented that "the greater the satisfaction with the existing computing system, the less the likelihood of adopting [a new system]." Nevertheless, knowledge of the technical and semantic attributes of older systems may be useful in hastening understanding of new IT. People with no prior IT use experience may find new systems daunting and frustrating (Lazar et al., 2006). Ifinedo and Nahar (2009) found a positive relationship between satisfaction with legacy systems and ERP success. Hence:

H6a: Satisfaction with old (legacy) systems would have a positive effect on the assessment of ERP system quality

H6b: Satisfaction with old (legacy) systems would have a positive effect on the assessment of ERP information quality

ERP success dimensions, i.e. system quality (SYSQ), information quality (INFQ), individual impact (INDI), and organizational impact (ORGI): In line with the nomological, casual conceptualization of IS success measurement in the D&M model, it is generally accepted that increases in system and information qualities leads to increases in individual impact, which in turn has positive impact on organizational impact. Previous research have confirmed such positive relationships (Wixom and Watson, 2001; Hwang and Xu, 2008) as did ERP system studies (Gable et al., 2008; Ifinedo et al., 2010).

H7a: ERP system quality would have a positive effect on ERP individual impact

H7b: ERP information quality would have a positive effect on ERP individual impact

H7c: ERP individual impact would have a positive effect on ERP organizational impact

## 4 Research Methodology

### 4.1 Data collection

A field survey was used to gather data from organizations in the three Nordic countries. Five hundred (500) companies were selected from applicable business lists and directories in each country. The developed questionnaire, which included validated items from the literature, was pre-tested by knowledgeable individuals, i.e. working professionals and university professors. Comments from the pilot test helped improve the quality of the final instrument. Participants in the main survey were asked to indicate an appropriate choice on selected statements.

The unit of analysis of this study was at the organization level; hence, key organizational informants including chief information officers (CIO), chief financial officers (CFO), directors, and knowledgeable business managers were contacted. Respondents were asked not to present their own personal views but that which represented their organizations'. Packets received by each participant consisted of a cover letter, questionnaire, and a self addressed, stamped envelope.

After sending out two postal reminders, 182 questionnaires were returned. Excluding the undelivered questionnaires, the study's effective response rate is 26%, which is adequate for a study such as this one. One hundred and sixty five (165) responses were deemed usable, (56, 57 and 52 firms from Norway, Sweden and Finland, respectively). Seventeen (17) of the returned responses were excluded due to incomplete questionnaires, too much missing data, and ERP system(s) that have been just been implemented in the adopting organization. The study's sample size is sufficient for this study and compares with those obtained for similar studies in the region (e.g. van Everdingen et al., 2000).

Our sampled firms' annual revenues ranged from €12 billion to a little over €1 million, with €150 million as the median. 62%, 12%, and 26% of the participants' organizations have 1 to 250, 251 to 999, and above 1000 employees, respectively. A broad assortment of industries, i.e. manufacturing, retail, metal works, chemical, oil and gas, forestry, transportation, and so forth were included. Major ERP packages such as SAP, Lawson Movex/M3, MS Dynamics (NAV), IFS, Basware, and so forth are in use in the sampled organizations. Seventy three percent (73%) of the participants were males. More than 76% of the respondents have university degrees. The respondents have an average of 9.7 years work experience (s.d. = 7.8) in their current organizations. Their job titles include CIO, CFO, controllers, project managers, accountants, and so forth.

We conducted a test for non-response bias by assessing whether non-response bias was a problem for the data. Namely, the data for each sub-sample was divided into two parts i.e. early and late respondents and a comparison made (Armstrong and Overton, 1977). Using the Chi-square ( $\chi^2$ ) test, we compared the sampled firms' size, country, annual revenue, industry type, and year of ERP implementation. The results of the tests (significant at  $p < 0.05$ ) did not reveal any statistical differences between the survey's non-participants (late respondents) and participants (early respondents) on the measures used.

Given that one individual presented views for their organization, common method bias (CMB) cannot be ruled out. CMB refers to a bias in the dataset due to something external to the measures used in the study. Such biases were contained by including views from across from differing job hierarchies and occupations. With such heterogeneity in the data sample, the potential of biases arising from CMB concerns diminishes. Regardless, procedural remedies for controlling CMB as recommended by Podsakoff et al. (2003) were followed. Clear and concise questions were used in the questionnaire to reduce participant's apprehension. Additionally, a statistical procedure, i.e. the Harmon one-factor test was used to assess if CMB was indeed problematic to the data sample. The test results (i.e. factor loadings) showed that several factors with eigenvalues greater than one are present in the data. The first factor accounted for 38.1% to indicate that CMB was not a problem for the collected data.



## 4.2 Operationalization of the constructs

We asked participants to indicate the percentage of the annual budget allocated to IT in their organizations. The choices ranged from  $\leq 2\%$  to  $>40\%$  on 6-point Likert type scale. The result indicated that 55% and 27% of the respondents come from organizations allocating less than 2% and 3-6% of company's budget to IT in their settings, respectively. For the size of IT department, we asked respondents how big their firm's IT departments were, using a scale ranging from very small (1) to very big (7). The average size of participants' IT department was small (mean = 2.52; s.d. = 1.54). We assessed IT function's value with a 4-point Likert ranging from not valued at all (1) to highly valued (4). The results showed that the IT function's value mean of the sample was 3.03 (s.d. = 0.81). The unitary scale of satisfaction with legacy IT was adapted from Ifinedo and Nahar (2009). The participants' mean satisfaction with their legacy IT, was 4.38 (s.d. = 1.38).

For external expertise, five measures were adapted from Ifinedo (2011a). For organizational IT skills/IT, four (4) measures relevant to this study were taken from Torkezadeh and Lee (2003) and Wu and Wang (2007); this construct's measures were anchored on a 7-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (7). As per the constructs of ERP system success dimensions, five (5) items from Ifinedo et al. (2010) were used. All the ERP success dimensions were anchored on a 7-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (7). Some of the study's variables and their items' descriptive statistics are shown in Table 2.

Construct/Variable	Measurement item
ERP system quality Mean = 4.72; S.D. = 1.26	Our ERP is flexible
	Our ERP is easy to use
	Our ERP is reliable
	Our ERP allows data integration
	Our ERP is efficient
ERP information quality Mean = 5.24 S.D. = 1.13	The information on our ERP is understandable
	The information on our ERP is brief/concise
	The information on our ERP is relevant
	The information on our ERP is usable
	The information on our ERP is available
ERP individual impact Mean = 4.61 S.D. = 1.16	Our ERP enhances organizational learning and recall for individual worker
	Our ERP improves individual productivity
	Our ERP is beneficial for individual's tasks
	Our ERP enhances higher-quality of decision making
	Our ERP saves time for individual tasks/duties
ERP organizational impact Mean = 4.54 S.D. = 1.24	Our ERP reduces organizational costs
	Our ERP improves overall productivity
	Our ERP provides us with competitive advantage
	Our ERP increases customer service/satisfaction
	Our ERP allows for better use of organizational data resource
External expertise Mean = 4.74 S.D. = 1.27	Our ERP external expertise (i.e. vendor/consultant) gives us prompt services
	Our ERP external expertise (i.e. vendor/consultant) is dependable
	Our ERP external expertise (i.e. vendor/consultant) has good relationships with my organization
	Our ERP external expertise (i.e. vendor/consultant) is experienced and provides quality training and services
	Our ERP external expertise (i.e. vendor/consultant) communicates well with my organization
Organizational IT skills/knowledge Mean = 4.56 S.D. = 1.13	How skilled are the employees of your organization on the computer issue related to evaluating systems features?
	How skilled are the employees of your organization with regard to using packaged application software?
	How would you rate the skill of your IT staff in terms of exploring new technology and knowledge?
	How skilled are the IT staff in your firm in terms of supporting end user computing?

Table 2. Some of the study's variables and their measurement items' descriptive statistics.

## 5 Data Analysis and Results

To analyze the data, we used the partial least squares (PLS) technique, which utilizes a principle component-base for estimation (Chin, 1998). PLS is suitable for prediction and theory development. PLS places minimal demands on sample size and residual distributions. For this study, SmartPLS 2.0 (M3) beta created by Ringle et al. (2005) was used. The literature of PLS suggests that information on two related measurement models, i.e. the measurement and structural models, be provided.

### 5.1 The measurement model

The following was used to assess the psychometric quality of the research's constructs: internal consistency reliability, convergent, and discriminant validities. Cronbach alpha coefficients and composite reliability measures as provided by SmartPLS 2.0 were used to assess internal consistency reliability. Cronbach alphas' and composite reliability's value of 0.7 are deemed satisfactory (Nunnally, 1978; Fornell and Larcker, 1981). Reasonably high values for relevant constructs in our data (Table 3) indicated that the research's construct reliability is assured. Convergent validity describes the degree to which a measure correlates with other measures that it is theoretically predicted to correlate with. It is evaluated using two means: a) item loadings greater than 0.7 indicate strong convergent validity results; b) the square root of the average variance extracted (AVE) for a construct is observed to see whether it explains at least half (50%) of the measures' variance. The AVEs for the multi-scaled constructs are above 0.50 to satisfy this requirement (Table 3).

Discriminant validity calculates the degree to which constructs are distinct or diverge from one another. This can be measured in three ways. First, Fornell and Larcker (1981) suggested a minimum value of 0.5 for a construct's AVE. As indicated, Table 3 shows all AVE values were above 0.50, which indicates that that principal constructs capture a much higher construct related variance than error variance. Second, the square root of AVE of the multi-item reflective constructs should be greater than the absolute value of the inter-construct correlations in the model (Chin, 1998). The square roots of the AVEs (in the diagonal element) highlighted in Table 3, were larger than all other cross-correlations. Third, constructs' cross-loadings should be observed to assess whether measuring items demonstrated high loadings on their own particular constructs and no indicators loaded higher on other constructs that were not theoretically designed to represent them. In this aspect, the results are satisfactory, but omitted in this paper, due to space considerations. Overall, the study's measures were psychometrically adequate as indicated by the foregoing results.

	CRA	CRO	AVE	EXTS	INDI	INFQ	ITBD	ITDS	ITVA	LEGA	ORGI	ORIT	SYSQ
EXTS	0.92	0.94	0.76	<b>0.87</b>									
INDI	0.84	0.89	0.61	0.54	<b>0.78</b>								
INFQ	0.85	0.89	0.63	0.51	0.60	<b>0.79</b>							
ITBD	NA	NA	NA	0.02	0.11	0.08	NA						
ITDS	NA	NA	NA	-0.10	0.01	0.05	0.24	NA					
ITVA	NA	NA	NA	0.01	0.16	0.07	0.18	0.12	NA				
LEGA	NA	NA	NA	0.27	0.32	0.30	0.08	-0.20	0.08	NA			
ORGI	0.88	0.91	0.67	0.55	0.76	0.57	0.10	0.01	0.12	0.35	<b>0.82</b>		
ORIT	0.70	0.73	0.52	0.07	0.24	0.28	0.17	-0.01	0.28	0.17	0.22	<b>0.72</b>	
SYSQ	0.81	0.87	0.57	0.58	0.72	0.66	0.14	-0.06	0.13	0.43	0.66	0.27	<b>0.75</b>

NA = Not applicable; AVE = Average variance extracted; CRA = Cronbach's alpha; CRO = composite reliability

Table 3. Cronbach's alpha, composite reliability, AVE, and inter-construct correlations.

## 5.2 The structural model

Information about the path significance of hypothesized relationships using the path coefficients, i.e. beta ( $\beta$ ) and the R squared ( $R^2$ ) is presented in the structural model. Figure 2 highlights the SmartPLS 2.0 results for the  $\beta$ s and  $R^2$ . Path significance levels (t-values) were determined using a bootstrapping procedure with 1000 samples. Chin (1998) indicated that  $R^2$  values of 0.67, 0.33, and 0.19 for the percentage of variance in a model are substantial, moderate and weak, respectively. The summary of the study's results are shown in Table 4. Of the fifteen (15) hypotheses formulated, nine (9) were confirmed; six (6) were unsupported by the data.

Hypothesis	Relationship	Beta ( $\beta$ )	t-value	Result
H1A	IT budgets $\rightarrow$ ERP system quality	0.07	0.924	Not supported
H1B	IT budgets $\rightarrow$ ERP information quality	-0.01	0.020	Not supported
H2A	IT department's size $\rightarrow$ ERP system quality	0.03	0.292	Not supported
H2B	IT department's size ERP $\rightarrow$ information quality	0.14	1.627	Not supported
H3A	External expertise $\rightarrow$ ERP system quality	0.50	6.533**	Supported
H3B	External expertise $\rightarrow$ ERP information quality	0.47	6.056**	Supported
H4A	Organizational IT skills/knowledge $\rightarrow$ ERP system quality	0.17	1.988*	Supported
H4B	Organizational IT skills/knowledge $\rightarrow$ ERP information quality	0.22	2.134*	Supported
H5A	IT function's value $\rightarrow$ ERP system quality	0.04	0.466	Not supported
H5B	IT function's value $\rightarrow$ ERP information quality	-0.03	0.346	Not supported
H6A	Satisfaction with old (legacy) systems $\rightarrow$ ERP system quality	0.27	2.992*	Supported
H6B	Satisfaction with old (legacy) systems $\rightarrow$ ERP information quality	0.17	1.986*	Supported
H7A	ERP system quality $\rightarrow$ ERP system individual impact	0.57	6.040**	Supported
H7B	ERP information quality $\rightarrow$ ERP system individual impact	0.23	2.498*	Supported
H7C	ERP system individual impact $\rightarrow$ ERP system organizational impact	0.76	17.019**	Supported

Note: \* significant at  $p < 0.05$  level; \*\* significant at  $p < 0.001$  level

Table 4. The summary of the study's results

H1A and H1B were rejected as IT budgets was not found to have positive effect on ERP system quality ( $\beta = 0.07$ ) and ERP information quality ( $\beta = -0.01$ ). H2A and H2B were unconfirmed as IT department's size did not have a positive effect on both ERP system quality ( $\beta = 0.03$ ) and ERP information quality ( $\beta = 0.14$ ). H3A and H3B were confirmed to indicate that external expertise have positive effects on both ERP system quality ( $\beta = 0.50$ ) and ERP information quality ( $\beta = 0.47$ ). H4A and H4B that suggested that organizational IT skills/knowledge have positive effects on ERP system quality ( $\beta = 0.17$ ) and ERP information quality ( $\beta = 0.22$ ) were unsupported by the data.

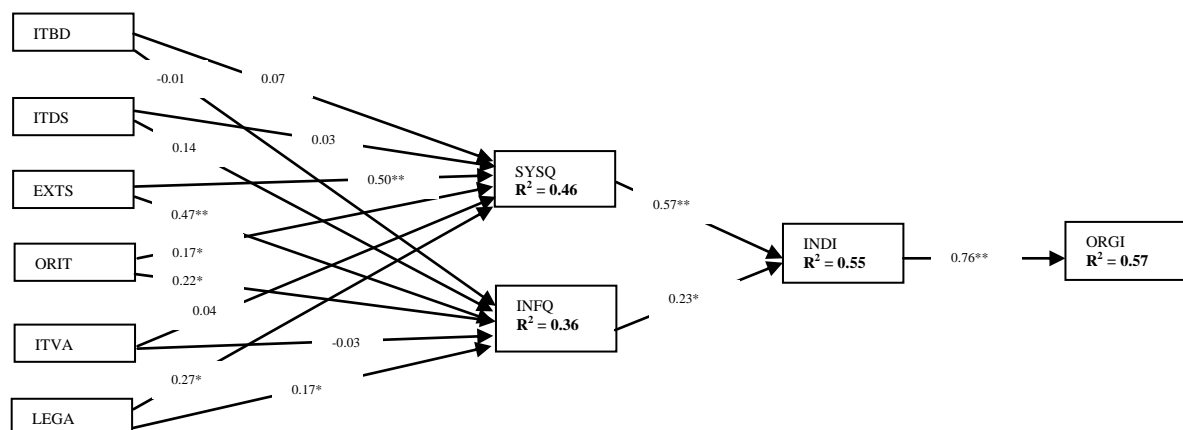


Figure 2. The SmartPLS 2.0 results

The data did not support H5A and H5B, i.e. the relationships between IT function's value and ERP system quality ( $\beta = 0.04$ ) and ERP information quality ( $\beta = -0.03$ ). As predicted, the data confirmed H6A and H6B, i.e. satisfaction with old (legacy) systems have positive effect on ERP system quality ( $\beta = 0.27$ ) and ERP information quality ( $\beta = 0.17$ ). ERP system quality have positive effect on individual impact ( $\beta = 0.57$ ) to support H7A. The data validated H7B to indicate that ERP information quality have positive effect on ERP individual impact ( $\beta = 0.23$ ). The result established substantial, statistical support for H7C, which predicted that individual impact would be positively related to ERP organizational impact ( $\beta = 0.76$ ).

The IT antecedent factors explained 46% of the variance in the ERP system quality; equally, the contingent factors explained 36% of the variance in the ERP information quality. The ERP system quality and information quality constructs explained 55% of the variance in ERP individual impact, which in turn accounted for 57% of the variation in ERP organizational impact. The amounts variance explained by the research shows that research model has between moderate to substantial relevance (Chin, 1998).

Plausible explanations for the unconfirmed set of hypotheses might be due to research design problems and extraneous factors. For example, while multi-scales were used to represent other constructs, IT budgets, IT department's size, and IT function's value were operationalized by unitary scales. Further to this, the majority of our study's participants come from small to medium-sized organizations; smaller organizations tend to have small or no IT departments at all, and their IT budgets are relatively smaller than larger organizations'. Clearly, the limited variability in the collected sample might have negatively impacted our data analysis in those aspects.

## 6 Discussions

Our research was designed to empirically assess the effects of relevant IT resources and assets on ERP system success. We employed CT and IS success evaluation frameworks to guide the discourse. The theoretical contributions and practical implications of the study are discussed next.

### 6.1 Theoretical contributions

This study diversified and complemented prior research examining the effects of relevant contingency factors i.e. top management support, organizational culture and structure, external expertise, internal IT knowledge and so forth on ERP system success. This present study is among the first of its kind to attempt to combine the effects of selected IT-related assets and resources on ERP success. Such an approach serves to deepen insight by providing nascent information regarding the critical importance of such antecedents on ERP success at later stages in the system lifecycle. Statistically, the variances explained by factors or variables considered in the proposed research model show that our research conceptualization has relevance for knowledge enhancement in the area.

With respect to CT, our study shows that ERP system success is positively enhanced by the selected antecedent or contingency factors chosen for this study. Our study's results may serve as a base in developing a contingency theory for ERP system success assessment. Regarding, IS success evaluation frameworks, our study has enriched the theory of IS success evaluation. In many respects, our study offers support for the findings reported in related studies with regard to the nature of relationships among the dimensions of IS success constructs (Wixom and Watson, 2001; Hwang and Xu, 2008; Gable et al., 2008; Petter et al., 2008; Ifinedo et al., 2010). It is safe to suggest that such related findings strengthen the domain of IS success evaluation, in general.

Our study adds to previous observations and insights in the literature signifying the relevance of external sources of IT expertise (Yoon et al., 1995; Markus and Tanis, 2000; Gefen and Ridings, 2002; Ko et al., 2005; Wang et al., 2008; Wang and Chen, 2006) and internal, organizational IT

skills/knowledge (Yoon et al., 1995; Markus and Tanis, 2000; Lee and Lee, 2004; Somers and Nelson, 2003; Amoako-Gyampah, 2007; Ifinedo 2011a; 2011b) in enhancing the effectiveness and success of applications such as ERP in organizations. In that respect, we contribute to viewpoints indicating that where quality external ERP expertise exists and the organization's employees (both IT and non-IT) possess appreciable levels of computer/IT skills and knowledge, the transfer of knowledge needed to ensure the effectiveness of such complex systems can be assured (Ko et al., 2005; Wang and Chen, 2006).

The main contribution of this study relates to the effect of satisfaction with old (legacy) systems on ERP success. Our result indicated that firms can be satisfied with their existing old IT and still assess the success of their newly acquired ERP positively. The overwhelming belief among researchers is that such old systems are no good, and may hamper the effectiveness of newer enterprises systems (Davenport, 1998; Markus and Tanis, 2000; Themistocleous and Irani, 2001; Ng and Tan, 2004; Mabert et al., 2003; Amoako-Gyampah, 2007). However, the result of our data analysis offers a differing viewpoint. To the best of our knowledge, this study's result appear to contradict widely held view on the matter, and may spur on further inquiry in the area.

## **6.2 Practical implications**

To begin with, practitioners need to be aware that newly acquired ERP can exist alongside old (legacy) systems. Where new ERP have been implemented, our data implies that the success or effectiveness of such new systems can still be achieved. Perceptions (positive or otherwise) of legacy systems do not seem to impede favorable ratings of ERP systems in contexts where both are present. To accommodate such realities, vendors of ERP and similar systems may consider offering enterprise application integration (EAI) to integrate not only applications such as customer relationship management, business intelligence, supply chain planning systems, and so forth, but extend such facilities to valued old (legacy) systems in use where their products are being adopted. In light of workers' attachments to such old systems (Chau and Tam, 1997; Ng and Tan, 2004; Amoako-Gyampah, 2007), solutions that integrate old systems with new ones such as ERP may appeal to organizational stakeholders.

ERP adopting organization will be able to reap the benefits of its investment in ERP packages by having employees (IT and business professionals) who possess quality computer/IT or knowledge. It has been shown that where internal IT skills are high, pre- and post-ERP implementation success tends to be favorable. Accepting the gains to be realized by having such in-house knowledge resource, adopting organizations can further enhance their chances of succeeding with their ERP at all stages in the system lifecycle. Relevant computer and IT trainings (generic and specific) for all personnel may offer a way forward. Corporate managers should ensure the training of workers lacking in computing skills or IT expertise before embarking upon the acquisition of complex IT systems such as ERP. The benefits of such an exercise could enhance the long-term success of such packages. Our study reinforces the need for IS/IT educators to continue to provide knowledge, skills, expertise and capabilities that would enable new graduates (IT and others) meet the general requirements of ever-changing business environments (Peslak and Davis, 2009).

Broadly, internal skills and competences needed for ERP implementations are often limited in adopting organizations compared to what external expertise offers (Markus and Tanis, 2000; Gefen and Ridings, 2002; Ko et al., 2005; Wang and Chen, 2006). Our data lends support to the viewpoint indicating that organizations that engage the services of knowledgeable, dependable, and committed external experts would be ensuring the long-term success of their ERP systems. Our study also shows that the effects of external expertise on ERP quality dimensions are more significant than the other IT antecedent factors. This suggests that the engagement of quality external sources of expertise (i.e., vendors/consultants) for ERP acquisitions can, to some degree, compensate for an organization's internal IT knowledge/skills. This foregoing proposition is tempered by the fact that ERP external

experts are known to be adept at transferring complex knowledge about their software to organizational members (Markus and Tanis, 2000; Klaus et al., 2000; Ko et al., 2005). To ensure favorable outcomes, practitioners should ascertain the quality of such external sources of expertise prior to their engagements.

Management of ERP adopting organizations can use workers' assessment of the semantic and technical qualities of acquired systems as a prescriptive tool in gauging the long-term impact or success of the system. Where workers' assessment of the quality attributes of ERP packages is low and unfavorable, it is likely that the future success of the system will not be assured. In general, our study is useful to the management of ERP in adopting organizations in so far as such information is made available to practitioners.

### **6.3 Limitations and future research opportunities**

Our study has its limitations. We employed subjective and perceptual measures; it is possible that an objective measure of ERP success, i.e. profit and productivity indicators might generate a dissimilar result from one presented here. Even though CMB was not a problem for our data, it is possible participants may experience a *halo effect*, meaning that those with favorable impressions of their ERP applications will offer positive responses. What is more, those with negative perceptions will present adverse views. Considering that we collected data in one technologically advanced region of the world; findings from other regions, for example developing may differ from ours. Thus, the generalizability of our study's findings to all contexts/regions should be done with caution. We used a cross-sectional field survey for our study; more insight may be facilitated with longitudinal data. Deeper insights could have emerged if multiple-item scales had been used for all constructs.

Future research should aspire to tackle the limitations highlighted in this study. For example, differing regions of the world and public-sector organizations' views should be included in future study to enrich insight. Multiple-item scales should be used for all constructs. Other theoretical frameworks such as the resource-based view could be integrated into our research model to further engender knowledge. The effects of the selected IT antecedents used in this study could be investigated for similar enterprise systems such as customer relationship management and supply chain management systems.

## **7 Conclusion**

More information is needed to understand factors positively influencing the success or effectiveness of ERP systems for adopting organizations. This current study was designed to shed light in the area. A research model that built upon CT and IS success evaluation model was used to empirically examine the effects of relevant IT assets and resources on ERP success. The findings of the study indicated that external ERP expertise and organizational actors' IT skills/knowledge have positive effects on ERP system success, with the former being more significant in our research conceptualization. As such, the engagement of quality external ERP expertise augurs well for the success of such business packages. Satisfaction with legacy systems does not appear to have adverse effect on the assessment of ERP success. We alerted that the attention of practitioners to the fact that newly acquired ERP can exist alongside legacy IT systems. Put differently, the success of ERP systems is not compromised by workers' satisfaction with their legacy systems. To ensure success with acquired ERP, adopting organizations should ensure that the quality attributes, i.e. semantic and technical are appropriately assessed by organizational members that use such applications. Information provided herein benefits and enriches perspectives for both academicians' and practitioners' communities.

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