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Relationships among ERP post-implementation success constructs: An analysis at the organizational level

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ABSTRACT

Enterprise resource planning (ERP) systems implementation success factors have been widely researched; however, few have investigated ERP post-implementation success in organizational contexts. The paucity of research into ERP system success evaluations partly motivates this research. To that end, the objective of this study is twofold. First, it primarily investigates the relationships among six constructs or dimensions in a respecified ERP system success measurement model, which was developed from prior relevant frameworks. Second, this research adds to the body of knowledge in the information system (IS) success evaluation domain, especially with its focus on ERP packages. The extended ERP system success model was tested using data collected in a cross-sectional field survey of 109 firms in two European countries. Structural equation modeling (SEM) was used to test six relevant hypotheses. The SEM results showed that five out of the six hypotheses have significant, positive associations. Namely, the constructs of *System Quality*, *Service Quality*, *Individual Impact*, *Workgroup Impact*, and *Organizational Impact* have strong relevance in ERP success conceptualization, whereas *Information Quality* does not, at least, in the context of our data. The pertinence of the study's findings for IS success evaluation as well as its implications for practice and research are discussed.

1. Introduction

The drive for higher levels of productivity, effectiveness, and organizational performance continue to push modern businesses towards adopting enterprise resource planning (ERP) systems (Davenport, 1998; Ifinedo, Udo, & Ifinedo, 2010; Mabert, Soni, & Venkatraman, 2003). ERP systems are applications that facilitate the integration of business information processes across functional units in an organization (Klaus, Rosemann, & Gable, 2000; Markus & Tanis, 2000). Research studies and industry reports indicate that both practitioners and information systems (IS) researchers place a lot of interest in this software (Esteves & Pastor, 2001; Hamerman, 2008; Mabert et al., 2003). For example, Esteves and Pastor (2001) draw attention to several ERP studies published in IS literature, and a recent industry report by Hamerman (2008) reveals that "The ERP applications market, currently about $38 billion in total revenue, is growing at an annual rate of 6.9% and will reach $50 billion by 2012." Despite the popularity of ERP systems globally, many adopting organizations have come to realize that the deployment of such systems were not as effective as expected (Wang, Shih, Jiang, & Klein, 2008; Zhu, Li, Wang, & Chen, in press).

Much of the extant literature on ERP applications tends to focus on issues related to their adoption, implementation critical success factors (CSF), and implementation methodologies (Akkermans & van Helden, 2002; Esteves & Pastor, 2001; Hong & Kim, 2002). Very few studies have appeared which focus on other aspects of ERP applications (Ifinedo & Nahar, 2007; Ifinedo et al., 2010; Yoon, 2009; Zhang, Leeb, Huanga, Zhang, & Huang, 2005; Zhu et al., in press; Zviran, Pliskin, & Levin, 2005). The assessment of post-implementation success of ERP packages in adopting organizations is one area that is not sufficiently researched (Sedera, Gable, & Chan, 2004; Wu & Wang, 2006a, 2007; Zhu et al., in press). The paucity of research into ERP system success evaluations partly motivates this current research study. It has been suggested that IS success measurement is a fuzzy concept; it has different meanings to different stakeholders in their assessment of different types of IS across different cultural contexts (Agourram, 2009; Jiang & Klein, 1999; Seddon, Staples, Patnayakuni, & Bowetell, 1999; Soh, Kien, & Tay-Yap, 2000; Zhu et al., in press). Citing Jiang and Klein (1999), DeLone and McLean (1992, p. 17) comment that "users prefer different success measures, depending on the type of system being evaluated." Measuring the success of ERP is particularly

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difficult perhaps due to the complexity of the system (Klaus et al., 2000; Markus & Tanis, 2000; Zhu et al., in press) and the sort of expertise required to carry out such an exercise (Gable, Sedera, & Chan, 2008; Robbins-Gioia, 2006; Seddon, 1997; Sedera et al., 2004). Unlike other traditional, single-function IS, the deployment of ERP systems is accompanied by business process engineering efforts that are intended to bring about radical, organizational change to enhance greater effectiveness for the adopting organization (Davenport, 1998; Holsapple, Wang, & Wu, 2005; Klaus et al., 2000; Yoon, 2009). Further, the integrative nature of ERP applications makes their implementation more complex than that of traditional IS (Markus & Tanis, 2000; Wang & Chen, 2006).

Seddon (1997, p. 11) discussed the general poor state of IS evaluations in organizations by noting "many firms do not conduct rigorous evaluations of all their IT investments" because they lack knowledge in such areas. Further evidence of this deficiency of knowledge regarding how firms assess the benefits of ERP is illustrated in a study conducted by Robbins-Gioia (2006). In this study, a survey of 232 respondents in American organizations reported that "46% of the participants noted that while their organization had an ERP system in place ..., they did not feel their organization understood how to use the system to improve the way they conduct business." The inference from the foregoing information is that ERP adopting firms do not know what to assess or evaluate in order to realize the benefits from their investments in such technologies. Thus, lack of knowledge on the part of some practitioners as to what to measure or assess with regard to ensuring the effectiveness of their ERP application is another motivation for this study. It is a fact that little consensus exists between researchers and practitioners about what to assess when it comes to the impacts and effectiveness of IS in organizations (DeLone & McLean, 1992; Gable et al., 2008; Saarinen, 1996; Sabherwal, Jeyaraj, & Chowa, 2006; Stefanou, 2001).

Research in the specific area of ERP systems success measurement, evaluations or assessment is just beginning to evolve (Gable et al., 2008; Ifinedo, 2006; Ifinedo et al., 2010; Sedera, Gable, & Chan, 2003, 2004). Some ERP success researchers have used a single-dimension of success, i.e., user satisfaction, to assess the effectiveness of the software (Nelson & Somers, 2001; Somers, Nelson, & Karimi, 2003; Wu & Wang, 2006a, 2007; Zviran et al., 2005). Others have proposed frameworks that do not readily lend themselves to empirical testing and validation (e.g., Markus & Tanis, 2000; Tan & Pan, 2002). This present study builds upon the ERP success measurement framework proposed by Sedera and colleagues (Gable et al., 2008; Sedera et al., 2004). Their model was based on the widely accepted IS success measurement developed by DeLone and McLean (1992) hereafter referred to as the D&M (1992) IS success model. The Sedera and colleagues' ERP success framework was considered for this study given the recent support it received from the proponents of the D&M (1992) success model (see Petter, DeLone, & McLean, 2008) and for its simplicity.

To consolidate IS success evaluation theory in general and ERP system success measurement in particular, it is critically important that any emerging model(s) be empirically tested (DeLone & McLean, 1992, 2003; Gable et al., 2008; Rai, Lang, & Welker, 2002; Sabherwal et al., 2006; Seddon, 1997). DeLone and McLean (1992) and Petter et al. (2008) note that the science of IS success evaluation stands to benefit from research efforts which empirically test and validate the relationships between the dimensions or constructs in any emerging success measurement model. In fact, DeLone and McLean (1992, p. 88) conclude that "By studying the interactions along these components of the model [i.e., dimensions of IS success], as well as the components themselves, a clearer picture emerges as to what constitutes information systems success." Along the same line of reasoning, Sabherwal et al. (2006) assert that much needs to be done with regard to enhancing insights about the relationships among constructs of IS success frameworks. They further add that such studies could benefit from the testing of potentially important constructs from prior parsimonious IS success models.

To that end, this present research effort is designed to contribute to the literature by investigating relationships among constructs of an extended, respecified ERP system success measurement model. Moreover, given the lack of much scholarship on IS success evaluation at the organizational level (Petter et al., 2008); we also hope to increase insight regarding assessment in that context as well. It is important to mention that the purpose of this present work is not to test the original D&M (1992) IS success model *per se*, as several IS researchers (see, e.g., Iivari, 2005; Petter et al., 2008; Rai et al., 2002) have already published works in that domain. Rather, this present effort is directed at complementing and advancing the work of Sedera and colleagues in the area of ERP system success measurement.

To the best of our knowledge, this present effort is among the first of its kind to examine interrelationships among ERP success dimensions beyond the implementation stage. Other researchers including Akkermans and van Helden (2002) have already studied interrelations among CSF in the early stages of ERP implementation. This current study complements such efforts by focusing on the evaluation of the system's success at later stages in its life cycle. It is important to avoid conflating ERP implementation success issues with "success matters" occurring at latter stages in the system life cycle.

Our study did not deem it necessary to utilize single-construct assessments of success, i.e., the user satisfaction instrument, which others (e.g., Somers et al., 2003; Wu & Wang, 2006a, 2007; Zviran et al., 2005) have employed in prior studies. We accept that the discourse of ERP success assessment in adopting organizations from the viewpoint of user satisfaction alone is simplistic, incomplete, limited, and may be misleading (DeLone & McLean, 1992; Saarinen, 1996; Sedera et al., 2004). As noted above, ERP packages present the adopting organization (and its sub-units) with broad impacts that exceed usage satisfaction for the individual (Davenport, 1998; Klaus et al., 2000; Markus & Tanis, 2000; Zhu et al., in press). An endeavor that takes such an issue into account is welcoming.

2. Research context and theoretical background

2.1. Research scope and setting

Our notion of ERP system success is different from *ERP implementation success* in that the former refers to the utilization of such systems to achieve organizational effectiveness (Gable et al., 2008; Myers, Kappelman, & Prybutok, 1996, 1997). In IS literature, the term "success" has been used synonymously with effectiveness (see Markus & Tanis, 2000; Thong, Yap, & Raman, 1996), and we concur with Thong et al. that the effectiveness of an IS can be "defined as the extent to which an information system actually contributes to achieving organizational goals" (p. 252). Our ERP success excludes the technical installation success of such systems that employ cost overruns, project management metrics, and time estimates among other issues as measurement indicators (Markus & Tanis, 2000; Martin, 1998).

Some researchers have discussed the value, benefit, or success of ERP systems using financial indicators (e.g., Stefanou, 2001); this study did not operationalize ERP success with such markers owing to the inherent limitations of this approach. DeLone and McLean (1992, p. 74) note that "MIS academic researchers have tended to avoid performance measures (except in laboratory studies) because of the difficulty of isolating the effect of the I/S effort from other effects which influence organizational performance." Further, the respecified, extended ERP systems success model discussed in this research is composed of subjective and perceptual measures. Objective measures deal with the extent to which the system has actually enabled organizational effectiveness through such measurements as improved delivery times, reduced stock turnover, reduced administrative costs, and so forth (Stefanou, 2001). The fact is that objective measures are difficult to quantify and obtain from organizations (Mabert et al., 2003). Rather, we focus on perceptual measures that are easy to collect from organizations and also lend themselves to instrument development (Gable et al., 2008; Ifinedo & Nahar, 2007). The shortcoming of perceptual measures is that people (respondents) sometimes may not say what they mean or say what they do not mean (Seddon, 1997).

Some may ask: why not use the D&M (1992) IS success model instead of proposing another one for ERP systems? It is worth noting that ERP is a different class of IS. The adoption of such systems differs from other traditional IS in two main areas. First, the implementation of ERP packages brings about business process engineering efforts aimed at radically changing the adopting organization. For example, workers in the organization have to be retrained and prevailing organizational procedures and processes discarded to make way for new designs and approaches (Holsapple et al., 2005; Klaus et al., 2000; Markus & Tanis, 2000). According to Klaus et al. (2000) and Holsapple et al. (2005), ERP can be viewed as a deterministic technology in so far as it forces work processes to be modeled along best practices and modules supported by the software. Second, unlike the deployment of other IS applications, implementing ERP is a complex activity; indeed, adopting organizations find it difficult to initiate such an endeavor without the benefit of external knowledge (Ko, Kirsch, & King, 2005; Markus & Tanis, 2000; Wang et al., 2008). As a consequence, success measurement models used for other typical IS success evaluations may not be adequate for ERP systems. In fact, it is has been argued that a specialized success measurement framework is needed for its success or effectiveness assessment (Gable et al., 2008; Ifinedo, 2006; Sedera et al., 2004; Wu & Wang, 2007). Thus, it is illuminating when attention is paid to ERP applications, particularly rather than lumping them together with other IS.

It is important to stress that our focus on ERP is at a generic level (i.e., we concentrated on its basic functionality rather than distinguish between top brands and mid-market ERP products). Indeed, empirical evidence exists suggesting that, in some respects, the benefits of ERP packages may be comparable even when system types differ (Fisher, Fisher, Kiang, & Chi, 2004; Mabert et al., 2003). It is safe to suggest that the diversity of ERP systems in our sample may engender the generalizability of our findings.

The data for this study was collected in two neighboring technologically advanced Northern European countries, i.e., Finland and Sweden. Firms in both countries started adopting ERP systems in the late 1990s (Ifinedo et al., 2010; van Everdingen, Hillegersberg, & Waarts, 2000). Our focus is on private organizations in both countries in contrast to the public sector organizations that Sedera and colleagues studied in Australia. Mansour and Watson (1980), writing about the performance of IS in organizations, asserted that a government environment differs from a private one because of the intense competition usually seen in the latter.

Both countries share a past history and have similar cultural values (Hofstede, 2003; Singleton, 1989). It is also worth noting that the literature suggests national culture might have a bearing on ERP processes implementation (Soh et al., 2000) and it may influence the perception of IS success evaluation (Agourram, 2009). Although our data comes from two different countries, we are assured of the homogenous nature of the sample on a major differentiator, i.e., national cultural values. More importantly, subsequent analyses of data collected in each country yielded analogous interpretation and insight to provide justification for combining data from the two countries.

2.2. Theoretical background

Researchers and practitioners continue to grapple with how to measure or evaluate IS benefits and value for organizations (DeLone & McLean, 1992; Gable et al., 2008; Myers, Kappelman, & Prybutok, 1997; Saarinen, 1996). One stream of research focuses on the use of attitudinal, perceptual, and subjective measures (e.g., Doll & Torkzadeh, 1988) while another utilizes financial and objective parameters (e.g., Barua, Kriebel, & Mukhopadhyay, 1995; Stefanou, 2001). In both cases, insights related to the effectiveness or success of the IS in organizations could be limited when the dimensions and measures of success are restrictive (Gable et al., 2008; Myers et al., 1996, 1997). The plethora of IS success assessment approaches led DeLone and McLean (1992) to develop an integrated, multidimensional, and inter-related IS success measurement model (Fig. 1) that has become the most dominant framework for assessing IS success at the micro level (Ballantine et al., 1997; Iivari, 2005; Petter et al., 2008). The D&M (1992) IS success model is rooted in the mathematical theory of communication (Shannon & Weaver, 1949).

The D&M (1992) IS success model offers two main contributions to the IS literature: First, it basically provides a schema for categorizing the various IS success measures that have been used to assess the effectiveness or success of IS. Second, it implies a casual relationships between the dimensions/constructs of IS success. Despite its popularity, criticisms have been leveled against it (Ballantine et al., 1997; Seddon, 1997). These authors claim that the D&M (1992) IS success model is confusing as it combines both causal and process explanations of IS success. DeLone and McLean (2003) later clarified that their model is best viewed as a casual model. A causal model is simply an abstract model that uses cause and effect logic in describing the behavior of a system. In other words, a casual model suggests that increases in one entity, A will cause corresponding increases in B.

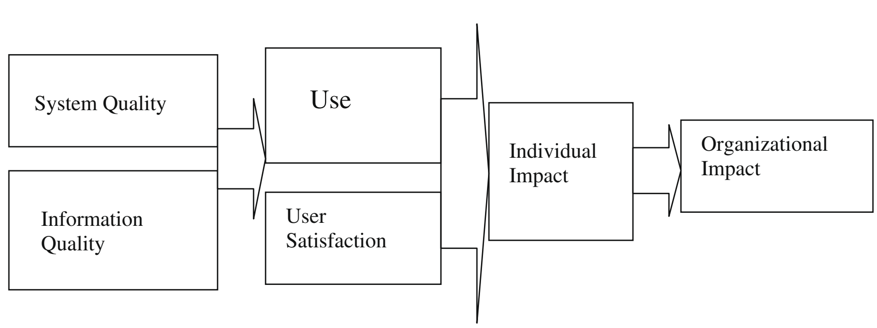

Fig. 1. DeLone and McLean (1992) IS success evaluation model.

In their influential works, DeLone and McLean (1992, 2003) called on IS researchers to examine the possible interactions among the success dimensions and make an attempt to reduce significantly the number of different measures used to assess IS success so as to facilitate validation. Drawing from the work of DeLone and McLean, Sedera and colleagues (Gable et al., 2008; Sedera et al., 2004) developed an additive model that redefines the original D&M (1992) IS success evaluation model. Working in the context of ERP applications and heeding the call to reduce the IS measurement model, Sedera and colleagues eliminated (through multi-stage data collection and statistical analysis) the *Use* and *User satisfaction* dimensions in the original D&M success model. In a recent article, DeLone, McLean, and their colleague note that "Sedera et al.'s (2004) multidimensional success instrument provides higher content validity. Their research has proven to be a valid and reliable step toward improved IS success measurement and either their instrument [model] or their approach ... be adopted and further tested in different contexts" (Petter et al., 2008, p. 256).

The utilization of *Use* and *User satisfaction* in IS success evaluations has elicited intense, sustained criticism from several researchers (see, e.g., Gable et al., 2008; Saarinen, 1996; Seddon, 1997). Some postulate that *Use* is an antecedent of IS effectiveness rather than a dimension (Gable et al., 2008); others consider it an inappropriate measure of IS success. Seddon (1997) argues that IS *Use* is a behavior and not a success measure. However, others have also argued that *Use* as a measure of success, is valid where IS use is voluntary (DeLone & McLean, 1992; Iivari, 2005). With respect to ERP applications, Sedera et al. (2004) found that *Use* was not an appropriate indicator of success as the utilization of such packages is often mandatory in adopting organizations (Holsapple et al., 2005; Hsieh & Wang, 2007). As noted above, modern organizations adopt ERP systems to effect positive changes to organizational processes, and according to Holsapple et al. (2005), satisfied ERP employees are more likely to be productive, especially where the use of such systems is mandatory. A note of caution has to be sounded here. Evidence in the literature indicates that system use though necessary may not be sufficient to enhance system benefits (Holsapple et al., 2005; Iivari, 2005; Seddon, 1997).

Similarly, *User satisfaction* can be viewed as a consequence of "succeeding" IS for adopting organizations instead of a dimension of success (Gable et al., 2008; Seddon, 1997). According to Rai et al. (2002) *User satisfaction* has been adequately assessed using other IS success dimensions, i.e., *Information Quality* and *System Quality* in prior studies. Regardless, the rigorous, multi-stage analyses performed by Sedera and colleagues did not support the inclusion of *User satisfaction* as a separate dimension of success for ERP applications. As a result, the ERP success dimensions retained in Sedera and colleagues' model are *System Quality*, *Information Quality*, *Individual Impact*, and *Organizational Impact* (Fig. 2). Importantly, Sedera and colleagues indicated that the most critical ERP success dimension is *Organizational Impact*. An ERP package is considered successful at the post-implementation phase, if it enhances potential benefits through organizational cost reductions, higher

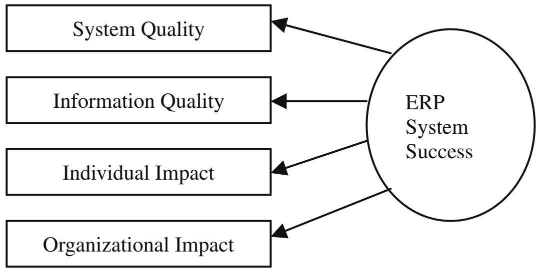

Fig. 2. Sedera and colleague's ERP success model.

operational productivity, increased customer satisfaction levels, and so forth (Saarinen, 1996; Sedera et al., 2004). It is worth noting that other researchers have used the Sedera and colleagues' model of ERP success in their works (e.g., Ifinedo, 2007; Sehgal & Stewart, 2004; Wang et al., 2008; Yoon, 2009; Zhu et al., in press).

DeLone and McLean (1992, 2003) argue for relevant constructs to be considered in the refinement of IS success measurement models. Perhaps this recommendation might have influenced others (Ifinedo, 2006; Ifinedo & Nahar, 2007) who used the Sedera and colleagues' model as a base and subsequently added a new dimension of ERP success, i.e., the *Workgroup Impact*. Their concept of "workgroup" refers to sub-units and/or functional departments of an organization. Myers et al. (1997) had argued that the evaluation of IS success should not downplay impacts at the workgroup levels. Klein, Rai, and Straub (2007, p. 621) comment that "The Information Systems Success (DeLone and MacLean, 1992, 2003) formulates the presence of both individual and organizational performance with potential intermediate levels at different points in between (e.g., the business unit)." Others have provided rational for including such a level of analysis (Rousseau, 1979). To that end, Rousseau (1979, p. 536) stated that "Researcher on technology in organizations has generally given insufficient attention to the level at which technology is assessed." She added that the individual, sub-unit, and organizational levels are highly interdependent, and it would be worthwhile for research efforts to duly focus on each one separately.

Our attention is drawn to how DeLone and McLean (2003) collapsed the constructs of *Individual Impact* and *Organizational Impact* into "Net Benefits" when responding to criticism that IS can affect levels other than individuals and organizations. To some extent, this simplification, though logically sound does contradict the authors' views when they commented that "[t]he selection of success measures should also consider contingency variables, such as the independent variables being researched; ...the environment of the organization being studied; *the technology being used*; and the task and individual *characteristics of the system under investigation*" (DeLone & McLean, 1992, p. 88). Because ERP fundamentally links functional areas in an organization (Davenport, 1998; Klein et al., 2007; Markus & Tanis, 2000), we argue that it will be useful for its success measurement model to include assessment at all levels, a viewed already shared by Rousseau (1979), Myers et al. (1997), and Ifinedo (2006).

In a later publication, DeLone and McLean (2003) respecified their original model by incorporating *Service Quality*. The proponents of that construct, i.e., Pitt, Watson, and Kavan (1995) had argued that IS success evaluation could be incomplete if items related to the services provided by IS support are not duly considered. Several researchers have tested and found *Service Quality* to be applicable to the evaluation of IS system success (Jiang, Klein, & Crampton, 2000; Kettinger & Lee, 1997). Although, Sedera and colleagues did not include this dimension in their own framework, we believe the assessment of ERP effectiveness for adopting firms will benefit from its inclusion. The following three rationales are advanced in support of our claim: First, more and more organizations across the globe have started to use external sources of knowledge and expertise when implementing complex, contemporary technologies such as ERP (Gefen, 2004; Ko et al., 2005; Markus & Tanis, 2000; Wang & Chen, 2006; Wang et al., 2008; Westrup & Knight, 2000). Using the services of external experts is one of the adaptive changes that modern organizations make as they adopt and implement new technologies. In fact, Davenport (1998), Markus and Tanis (2000), and Klaus et al. (2000) all highlighted dependence on external service providers as a key issue for ERP implementations that differentiate it from other IS implementations. That is, the quality of service provided by the software suppliers (e.g., vendors and consultants) goes a long way in ensuring a

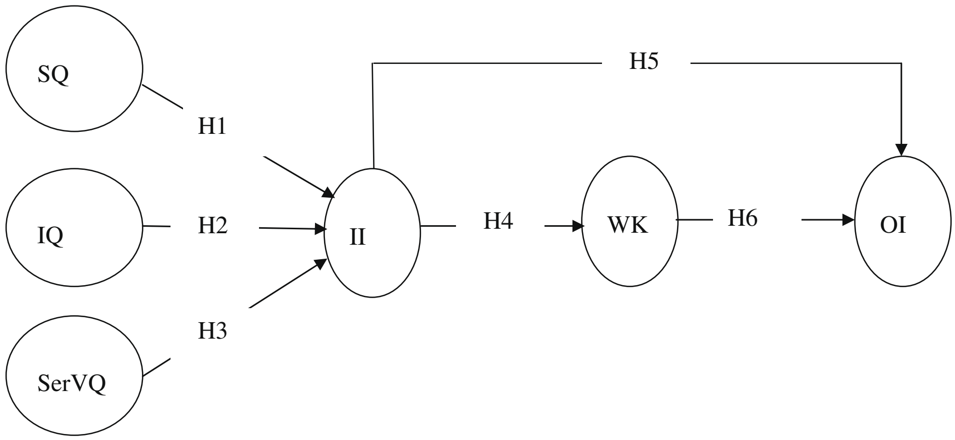

Fig. 3. The proposed ERP system success model tested in this study.

positive outcome for the adopting organization. Second, other ERP researchers (Ifinedo, 2006; Ifinedo & Nahar, 2007; Sedera et al., 2003; Wu & Wang, 2006a, 2007) having recognized the relevance of the package's providers in the system life cycle have proposed success measures to capture this important dimension. Third, DeLone and McLean (2003) note that the inclusion of *Service Quality* in IS success evaluation will permit useful insight to emerge. They believe it can be used to complement the other quality dimensions. DeLone and McLean (2003) also asserted that *Information* and *System Qualities* are more applicable to the individual user of IS, whereas *Service Quality* is an important variable in the wider organizational context.

Thus, our respecified ERP system success measurement framework (Fig. 3) has six inter-related, interdependent, dimensions/constructs of success. The nomological network leading to the success of the application in the adopting firm is implied in the conceptualization. The meaning of each of the dimensions is provided in Table 1. It is easy to notice that our proposed framework precluding the *Use* and *User satisfaction* constructs is different from the original D&M (1992) IS success model. Conceptualizations such as ours are not novel in IS success literature. Others including Wixom and Watson (2001), Wu and Wang (2006b), Hwang and Xu (2008), and Schaupp, Belanger, and Fan (2009) have presented success measurement in a similar manner.

3. Hypotheses formulation

In investigating the relationships among the dimensions or constructs in the proposed ERP success measurement model (Fig. 3), six relevant hypotheses have been formulated and their associated discussions presented below. In brief, we posit that the variance in *Organizational Impact* could be explained by the other ERP success dimensions.

In accordance with the variance model proposed in the D&M (1992) IS success model, it is presumed that there is a correlation between IS system quality attributes and the benefits obtained by individuals using such systems. The IS success model implies that when the quality attributes of an IS are perceived as high, the benefits that individuals using the system receive are high as well (Holsapple et al., 2005). In fact, Seddon and Kiew (1994), Rai et al. (2002), Calisir and Calisir (2004), Shih (2004), and more recently Schaupp et al. (2009) confirmed a positive relationship between system quality and "usefulness". The measurement items used in those studies roughly correspond with the constructs of *System Quality* and *Individual Impact* herein.

In the context of ERP systems, using multiple regression analysis, Calisir and Calisir (2004) reported that there was a significant path coefficient between perceived ease of use and perceived usefulness ($\beta = 0.381$) and between system capability and perceived usefulness ($\beta = 0.354$). Although Kositanurit, Ngwenyama, and Osei-bryson (2006) found a significant relationship between perceived ease of use and individual performance; they did not find any meaningful relationship between system reliability and the performance of individuals using ERP applications. Furthermore, using the structural equation modeling (SEM) technique, Ifinedo (2007) found *System Quality* to be positively associated with *Individual Impact* ($\beta = 0.39$). Similarly, Hsieh and Wang (2007) using SEM technique also found perceived ease of use ($\beta = 0.603$) and perceived usefulness ($\beta = 0.227$) to be positively related to the benefits that individuals derive from their ERP application. The foregoing information permits the suggestion that when ERP system quality is perceived to be high, the impacts to individuals using such systems will correspondingly be high. Therefore, we hypothesized:

Table 1
Definitions of the success dimensions.

Dimension	Description/meaning
System Quality (SQ)	Performance characteristics of the ERP system with regard to ease of use, accuracy, reliability, efficiency, and so forth
Information Quality (IQ)	Characteristics of the output provided by the ERP system with respect to timeliness, relevance, availability, and understandability, and so forth
Service Quality (SerVQ)	Support that the organization receives from the ERP provider, often operationalized by reliability, dependability, quality of expertise, and so forth
Individual Impact (II)	Concerned with the effect of ERP on the individual, often assessed through increased individual's productivity, improved decision-making capability, and so forth
Workgroup Impact (WI)	The impact of the ERP system on sub-units or departments within the organization often assessed through improved inter-departmental coordination, communication, and productivity
Organizational Impact (OI)	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

Hypothesis One (H1). In the context of ERP systems, there is a significant, positive relationship between *System Quality* and the *Individual Impact*

A recent meta-analytic study of the IS literature found moderate support for the relationship between the quality of information output and benefits that individuals derive from their use of IS (Petter et al., 2008). While studies carried out by Kraemer, Danzinger, Dunkle, and King (1993), Shih (2004), Wu and Wang (2006b), Hwang and Xu (2008), and Schaupp et al. (2009) reported positively relationships between perceived information quality and perceived usefulness (i.e., *Individual Impact*); others (e.g., Kulkarni, Ravindran, & Freeze, 2006) did not find such an association in their studies. It is possible that the mixed results could be attributed to the use of slightly different measuring items.

The work of Seddon and Kiew (1994), which pioneered the testing of the D&M (1992) IS success model found that increases in *Information Quality* led to more "usefulness" of an IS for the assessing individual. Likewise, Rai et al. (2002) in their empirical tests of Seddon (1997) and D&M (1992) success models found that *Information Quality* is positively related to perceived usefulness. With regard to ERP applications, Kwahk (2006) found strong support for ERP system utilization being positively influenced by perceived usefulness. Similarly, Ifinedo (2006) reported that *Information Quality* is positively related to *Individual Impact* (β = 0.27) and Kositanurit et al. (2006) also found that there was a significant, positive relationship between informational quality of ERP system and the performance of individuals using such systems. Thus, our second hypothesis is:

Hypothesis Two (H2). In the context of ERP systems, there is a significant, positive relationship between *Information Quality* and the *Individual Impact*

External sources of knowledge usually provide needed expertise and they also help to reduce the client learning burden (Ko et al., 2005; Wang & Chen, 2006). Knowledgeable service providers (i.e., vendors and consultants) make it easy for organizations to efficiently use complex IS such as ERP systems (Gefen, 2004; Markus & Tanis, 2000; Sedera et al., 2003; Westrup & Knight, 2000). However, Petter et al.'s (2008) review of the literature found moderate support for the relationship between service quality and benefits accruable to individuals. Research design and focus might have influenced the findings in the literature. Regardless, the benefits that organizations gain from external IS service support have been reported to be high when such providers possess needed expertise and knowledge (Ko et al., 2005; Thong et al., 1996).

Sedera et al. (2003) found that the benefit levels of employees using ERP is higher where the providers of the software are seen to be knowledgeable and helpful rather than lacking in such qualities. Gefen and Ridings (2002) showed that when users have contact with the ERP technical implementation team, their evaluations of the system tend to be more favorable than in instances where such contact was low. Other findings suggest that the perceived usefulness of ERP software increases with the client's trust in the vendor (Gefen, 2004; Ko et al., 2005). Thus, we hypothesize:

Hypothesis Three (H3). In the context of ERP systems, there is a significant, positive relationship between *Service Quality* and the *Individual Impact*

Ceteris paribus, when the effect arising from an IS is high for an individual, it is likely that the impact for the workgroup or sub-unit to which the individual belongs will be equally high. Moreover, it is to be expected that the entire organization will experience a positive outcome when its constituting entities are positively impacted. However, not much research has been done in this area of study. Among the few studies that have examined the nature of the relationship between *Individual Impact* and *Organizational Impact*, we noticed that Teo and Wong (1998) and Hwang and Xu (2008) found a positive, significant relationship between the two constructs while McGill, Hobbs, and Klobas (2003) and Ifinedo (2007) did not. To the extent that *Workgroup Impact* is considered a relevant dimension of IS success evaluations, Ifinedo (2007) provides evidential support for the direction of flow in the nomological network implied in the D&M (1992) IS success model. As noted above, Rousseau (1979) and Myers et al. (1996) argue that useful insights might emerge when all levels are given apt consideration in IS success evaluation studies. However, our search for literature establishing relationships – positive or otherwise – between *Workgroup Impact* and *Organizational Impact* did not yield any success with the exception of the ERP study by Ifinedo (2007) that found both constructs to be strongly positively related (β = 0.56). The foregoing discussion permits us to formulate the following set of hypotheses:

Hypothesis Four (H4). In the context of ERP systems, there is a significant, positive relationship between *Individual Impact* and *Workgroup Impact*

Hypothesis Five (H5). In the context of ERP systems, there is a significant, positive relationship between *Individual Impact* and *Organizational Impact*

Hypothesis Six (H6). In the context of ERP systems, there is a significant, positive relationship between *Workgroup Impact* and the *Individual Impact*

4. Research methodology

4.1. Data collection

A cross-sectional field survey was used to collect empirical data from Finnish and Swedish firms. We targeted 500 companies, with each country providing roughly half the number. In obtaining the names of the firms to contact for the survey, we used lists of top firms in both countries. Online sources, i.e., Affärsdata (http://www.ad.se/startpage.php), Suomenyritykse (http://www.suomenyritykset.fi/), ERP User Groups, and vendor lists, as well as recommendations from local ERP consultants were used in compiling ERP adopting firms. To make the results more general, we included firms from a variety of industries. In order to ensure content validity, eight knowledgeable individuals (i.e., 3 IS faculty, 2 ERP consultants, and 3 ERP managerial level users) completed the questionnaire prior to our mailing it; their comments helped us improve its overall quality. The survey instrument was designed for participants to indicate agreement on selected statements. The questionnaire also had sections for other information such as company annual revenue, workforce size, ERP type, and relevant demographic information.

As the unit of analysis of this study was at the organization level, we ensured that key organizational informants including chief information officers (CIO), chief financial officers (CFO), and other top business executives were contacted. They received a packet consisting of a cover letter, questionnaire, and a self addressed, stamped envelope. We focused on top- and mid-level managers from both the business and technical (IT/IS) sides of the organizations. These groups of respondents are among the most knowledgeable informants regarding ERP systems success evaluations in adopting organizations (Ifinedo & Nahar, 2007; Sedera et al., 2003). The respondents were encouraged not to present their own personal views but that which were representative of their organizations.

After two rounds of postal reminders, 122 questionnaires were returned (an effective response rate of 24.4%), although the usable responses for the research were only 109 (Namely, 57 and 52 firms came from Sweden and Finland, respectively). Our sample size is adequate for a study such as this one. Past studies on ERP adoption in the region as well as elsewhere (see van Everdingen et al., 2000) have used comparable sample sizes to ours. We did not include 13 of the returned responses for such reasons as incomplete questionnaires, responses with too much missing data, firms declining to participate, no ERP system(s) in the organization, and firms with ERP packages that were only deployed in the last two years. We decided not include the responses of firms that have just implemented their ERP packages for fear of not conflating ERP implementation success factors with this study's theme, i.e., post-implementation success issues.

The firms in our sample came from a wide spectrum of industries and major ERP packages such as SAP, Oracle, and so on are also represented in our sample. The annual revenue of the firms in the sample ranged from €8 billion to a little over €1 million, with €100 million as the median. The workforce ranged from 10 to 50,000 employees, with a median of 300 employees. The profile of the responding firms is presented in Table 2. The respondents' demographic profile is shown in Table 3. On average, the respondents have university degrees; 71% of them are males and 28% females. The majority of them were aged between 31 and 50 years, and had 9 years work experience ($SD = 7.9$).

To assess whether our respondents reflected the sampling frame of ERP adopting firms in the two countries, we tested for non-response bias in our sample by comparing early and late respondents (Armstrong & Overton, 1977). Chi-square (χ^2) test was used to compare the sampled firm's size, annual revenue, industry type, and year that ERP implementation was completed. The results of the Chi-square tests (significant at $p < .05$) showed there were no significant differences along these key characteristics.

Self-reported data often presents problems relating to social desirability and other issues that could cause the data to have a biased trait correlation. Such a problem with organizational research is commonly referred to as a common method bias. We followed the procedural remedies for controlling common method biases. First, we increased our study's validity by using clear and concise questions in the questionnaire. Second, we reduced apprehension by assuring respondents' anonymity. Third, a statistical procedure, i.e., the Harmon one-factor test was used to assess if such biases were a problem in our sample (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). The test results showed that several factors with eigenvalues greater than one are present in our data. As well, the most covariance explained by one factor in our data is 33.9% indicating that common method variance is not a problem for our data.

4.2. Instrument development

Each of the six constructs included in this study have multi-item scales derived from relevant prior studies. Each measure

Table 2
Firm demographics (number of organizations = 109).

Measure	Frequency	Percent (%)
Industry type		
Automobile Dealership	3	2.8
Bank, Insurance, Investment	4	3.7
Chemical & Pharmaceuticals	7	6.4
Dairy, Food, & Meat Products	9	8.3
Electrical & Electronics	4	3.7
Medical & Healthcare	2	1.8
Information Technology (IT)	4	3.7
Manufacturing	21	19.3
Material Handling & Metal	5	4.6
Retail/Wholesale/Distribution	20	18.3
Telecommunications	3	2.8
Transportation, Logistics, & Courier	11	10.1
Construction	3	2.8
Other (e.g., Engineering, Energy, Facility Management, Defense, Industrial Tools, Utility, Forestry)	13	11.9
Revenue (€ Euro Million)		
Over 1000	14	12.8
501–1000	7	6.4
251–500	17	15.6
101–250	16	14.7
Less than 100	50	45.9
Missing data	5	4.6
Number of employee		
Less than 50 employees	20	18.3
51–100 employees	12	11
101–500 employees	27	24.8
501–1000 employees	17	15.6
1001–10,000 employees	21	19.3
10,001 employees and above	10	9.2
Missing data	2	1.8
Organization's ERP software		
IBS (ASW, Enterprise)	8	7.3
Basware	6	5.5
IFS	8	7.3
IFS, Basware, SAP	2	1.8
JD Edwards (JDE)	6	5.5
Lawson Movex/M3	18	16.5
Oracle E-Business Suite	3	2.8
MBS Dynamics (Navision)	6	5.7
SAP	20	18.3
SAP, Lawson Movex/M3, JDE	3	2.8
Infor ERP (PRISM, System 21, BPCS)	2	1.8
SAP, JDE	1	0.9
Oracle, Infor ERP (PRISM), JDE, Oracle	1	0.9
Scala, JDE, BPCS & SAP, Oracle	2	1.8
Lawson Movex/M3 and In house ERP	1	0.9
In house ERP	6	5.5
Other (Nova, Aurora, Hansa, Liinos, Scala)	16	14.7

Table 3
Profile of respondents (number = 109).

Measure	Frequency	Percent (%)
Job title		
Accountants	4	3.7
CEO	5	4.6
CFO	10	9.2
CIO	13	11.9
Controller	6	5.5
Director (SCM, Operations, Admin, Sales)	7	6.4
IT Manager	23	21.1
Manager (Export, Quality, Marketing, Sales, Segment, Procurement)	28	25.7
VP Finance	6	5.5
VP IT	4	3.7
Other	3	2.8
Position in organization's hierarchy		
Top management position	43	39.4
Mid-level personnel	58	53.2
Staff	6	5.5
Missing data (Unknown)	2	1.8
Gender		
Male	77	70.6
Female	31	28.4
Missing data	1	0.9
Age (years)		
Less 20	0	0
21–30	4	3.7
31–40	37	33.9
41–50	39	35.8
51–60	27	24.8
Over 60	2	1.8
Education		
Secondary school	3	2.8
Vocational/Technical/Other	24	22
University	80	73.4
Missing (Unknown)	2	1.8

was anchored on a 7-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (7) on which participants were asked to indicate an appropriate choice. In total, 46 measures were used. For *Service Quality* we adapted measures from Pitt et al. (1995), Kettinger and Lee (1997), Thong et al. (1996), and Ko et al. (2005). Items used for *System Quality*, *Information Quality*, *Individual Impact*, and *Organizational* Impact were obtained from Sedera et al. (2004), Gable et al. (2008), and DeLone and McLean (1992). The measures used to operationalize the *Workgroup Impact* construct came from Myers et al. (1997) and Ifinedo (2007). Table 4 highlights the item sources and their descriptive statistics. A full list of the measures is provided in the Appendix.

5. Data analysis

To validate our hypotheses we utilized the structural equation modeling (SEM) for data analysis. We used the partial least squares (PLS) technique of SEM that utilizes a variance-based approach for estimation. The specific tool used was SmartPLS 2.0, which was created by Ringle, Wende, and Will (2005). Unlike the covariance based packages, i.e., LISREL that employs χ^2 statistics, PLS uses R^2 statistics and does not place strict demands on sample size and data normality. In general, the PLS approach is suitable for predicting the validity of models (Chin, 1998). Two assessments are supported by PLS: (a) the measurement model assessment – here the psychometric properties, i.e., item reliability, convergent and discriminant validities of the measurement scales are examined, and (b) the structural model assessment – this aspect presents information related to item loadings and the strength of paths in models. The path significance levels using *t*-values are estimated by the bootstrap method. SmartPLS 2.0 permits the use of the bootstrapping of 500 sub-samples for significance testing.

5.1. Assessment of the measurement model

Internal consistency is demonstrated when the reliability of each measure in a scale is above 0.7 (Nunnally, 1978). The results for two item reliability indicators, i.e., the Cronbach's α and composite reliability are shown in the Appendix. Some researchers (e.g., Barclay, Thompson, & Higgins, 1995) have suggested that composite reliability is similar to Cronbach's α and both can be interpreted in the same way. Each of the six scales had Cronbach's α and composite reliability exceeding the recommended value of 0.70 indicating adequate internal consistency. Convergent validity is adequate if each of the constructs in the model has an average variance expected (AVE) of least 0.50 (Fornell & Larcker, 1981). AVE measures the percentage of overall variance for indicators represented in a latent construct through the ratio of the sum of the captured variance and the measurement error (Hair, Anderson, Thatham, & Black, 1998). It is further recommended that the factor loadings of all items should be above 0.60 for convergent validity to be demonstrated (Hair et al., 1998). The factor loadings are presented in the Appendix; items with values lower than the recommended value of 0.60 are marked by an asterisk (*) and are subsequently excluded in further analysis.

Fornell and Larcker (1981) recommend that the following three conditions be met for adequate discriminant validity to be assured: (a) the square root of AVE of all constructs should be larger than all other cross-correlations; (b) all AVEs should have values above 0.5; (c) the principal component factor analysis should have item oadings greater than 0.6 on their respective constructs, and no item should load highly on any other construct(s). The results in Table 5 indicate that in no case was any correlation between the constructs greater than the squared root of AVE (the principal diagonal element); and all the AVEs were above the 0.5 threshold. The AVEs ranged from 0.50 to 0.61. As well, the SmartPLS confirmatory analysis results showed that all items loaded on the construct for which they were designed to measure. On the whole, our results showed the variance shared between each construct and its indicators are distinct and unidimensional. Thus, the discriminant validity of the scales used for this study is adequate.

5.2. Assessment of the structural model

SmartPLS 2.0 provided the squared multiple correlations (R^2) for each construct in the model and the path coefficients (β) with other constructs also given. The R^2 indicates the percentage of a construct's variance in the model, while the path coefficient indicates the strength of relationship between constructs (Chin, 1998; Ringle et al., 2005). Unlike other SEM such as LISREL, SmartPLS 2.0 does not generate a single goodness-of-fit metric for the entire model. Both the β and the R^2 are sufficient for analysis, and β values between 0.20 and 0.30 yield meaningful interpretations (Chin, 1998). The SmartPLS 2.0 results for the βs and the R^2s are shown in Fig. 4.

Table 4
ERP system success dimensions and their sources.

Dimension	No. of measures	Mean	Standard deviation	Sources
System Quality	11	4.77	0.76	Gable et al. (2008), Sedera et al. (2003), DeLone and McLean (1992)
Information Quality	7	5.29	0.76	Gable et al. (2008), Sedera et al. (2003), DeLone and McLean (1992)
Service Quality	7	5.00	0.82	Thong et al. (1996), Pitt et al. (1995), Kettinger and Lee (1997), Ko et al. (2005)
Individual Impact	6	4.48	0.82	Gable et al. (2008), Sedera et al. (2003), DeLone and McLean (1992)
Workgroup Impact	7	4.41	0.86	Myers et al. (1996, 1997), Ifinedo (2006)
Organizational Impact	8	4.58	0.89	Gable et al. (2008), Sedera et al. (2003), DeLone and McLean (1992)

Table 5
Inter-construct correlations, AVE, and the square root of AVE.

Dimension	AVE	1	2	3	4	5	6
1. System Quality	0.50	**0.707**					
2. Information Quality	0.58	0.663	**0.762**				
3. Service Quality	0.56	0.734	0.669	**0.748**			
4. Individual Impact	0.58	0.694	0.552	0.639	**0.762**		
5. Workgroup Impact	0.53	0.485	0.502	0.484	0.669	**0.728**	
6. Organizational Impact	0.61	0.721	0.624	0.630	0.765	0.700	**0.781**

Note: (a) The bold fonts in the leading diagonals are the square root of AVEs, (b) off-diagonal elements are correlations among constructs.

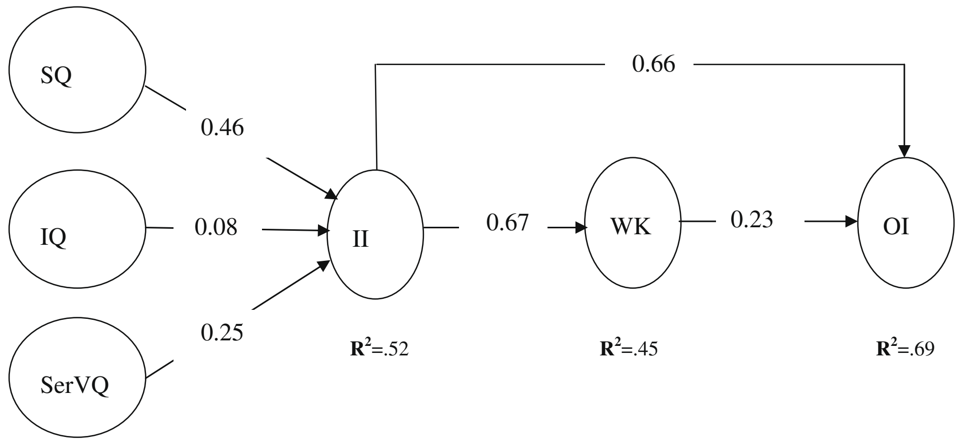

Fig. 4. The SmartPLS results for the tested hypothesized paths.

All but one of the six hypotheses was not supported. Contrary to our prediction, hypothesis (H2) was not supported by the data. That is, *Information Quality* was not found to have a significant, positive association with *Individual Impact* ($\beta = 0.08$, $t = 0.97$, $p = .332$). The hypothesized path (H1) between *System Quality* and *Individual Impact* ($\beta = 0.46$, $t = 3.98$, $p < .001$) was confirmed. The data supported hypothesis (H3), which predicted a significant, positive relationship between *Service Quality* and *Individual Impact* ($\beta = 0.25$, $t = 2.60$, $p < .01$). The three constructs jointly explained 52% of the variance in the *Individual Impact* construct.

Individual Impact has a significant, positive relationship with *Workgroup Impact* ($\beta = 0.67$, $t = 11.51$, $p < .0001$) to provide support for hypothesis (H4). The three preceding quality constructs and *Individual Impact* jointly explained 45% of the variance in the *Workgroup Impact* construct. Our data found support for the existence of a positive association between *Individual Impact* and *Organizational Impact* ($\beta = 0.66$, $t = 9.22$, $p < .0001$) to support hypothesis (H5). The result also demonstrated a statistical support for hypothesis (H6), which predicted a significant positive relationship between *Workgroup Impact* and *Organizational Impact* ($\beta = 0.23$, $t = 2.94$, $p < .01$); this prediction was confirmed. All the preceding constructs together explained 69% of the variance in the dependent model. As seen in Fig. 4, the relationship with the largest path coefficient is that between *Individual Impact* and *Workgroup Impact* ($\beta = 0.67$). The least path coefficient values are seen for the relationships between *Workgroup Impact* and *Organizational Impact* ($\beta = 0.23$) and *Service Quality* and *Individual Impact* ($\beta = 0.25$). Further discussion is presented in the next section.

6. Discussions

The goal of this research is to empirically test the relationships among the constructs/dimensions in a respecified ERP system success model. To that end, this current study built upon the D&M (1992) IS success framework, which Sedera and colleagues had recently drawn from. Our proposed extended ERP system success model has an adequate predictive power. The results showed that a large proportion of variance in model, i.e., 69% is explained by the variables. Our results provide strong support for five of our hypotheses. Hypothesis One (H1), which predicted a significant, positive relationship between *System Quality* and the *Individual Impact* in the context of ERP systems, is strongly supported by our data. This finding is consistent with other prior studies affirming the existence of such a relationship (Calisir & Calisir, 2004; Ifinedo, 2007; Rai et al., 2002; Schaupp et al., 2009; Seddon & Kiew, 1994). Thus, this finding seems to be suggesting that such a relationship might hold for a wide range of IS.

Surprisingly, our study did not give support for a positive association between *Information Quality* and *Individual Impact* as other prior studies have done (Ifinedo, 2007; Kraemer et al., 1993; Rai et al., 2002; Seddon & Kiew, 1994). We believe that this particular finding might have been influenced by the peculiar nature of ERP systems. Sammon, Adam, and Carton (2003, p. 159) commented that "ERP are good for storing, accessing and executing data used in daily transactions, but it is not good at providing information..." The authors added "Many [organizations] experience frustration when they attempt to use their ERP to access information and knowledge" (Ibid). In their ERP success evaluation study, Somers et al. (2003) also noted the difficulties associated with the informational quality of ERP systems. Although Zhang et al. (2005) assert that *Information Quality* is a major determinant of ERP success in adopting organizations; our data did not find support for such a claim. Perhaps the lack of support for the relationship between *Information Quality* and *Individual Impact*, in our data, is suggesting that more studies are needed to consolidate insight in this aspect of the package.

Our study found strong support for the positive relationship between the constructs of *Service Quality* and *Individual Impact* in the context of ERP applications. Thus, when the quality of service provided by ERP vendors and consultants is high, the benefits to individuals using such systems will be high as well. Although the path coefficient between these two variables is one of the least significant in the model; it nonetheless provides support to the conclusions made by others indicating that knowledgeable service ERP providers for adopting organizations is pertinent for benefits realization (Gefen, 2004; Gefen & Ridings, 2002; Ko et al., 2005; Sedera et al., 2003). The path between *Individual Impact* and *Workgroup Impact* was found to be significant enough to support the prediction in hypothesis (H4). This result, which has the largest path coefficient value ($\beta = 0.67$) therefore strongly affirms the view that potential impacts to the organization's sub-units will result from accumulated benefits that individuals in the organization get from their ERP packages. That is, when ERP systems are able to assist individuals in the organization to improve their productivity, decision-making processes, and overall performance, their own work-unit as well as other units in the firm will benefit similarly.

Similar to the discussions for hypothesis (H4), the strong association between *Individual Impact* and *Organizational Impact* is indicating that higher levels of benefits for the individual using ERP will ultimately lead to an overall gain for the adopting organization. In that respect, our result is consistent with the finding reported elsewhere (e.g., Hwang & Xu, 2008; Ifinedo, 2007; Teo & Wong, 1998) that found a strong correlation between these two constructs. Our sixth hypothesis (H6) was supported as well, to confirm the existence of a strong positive relationship between the constructs of *Workgroup Impact* and *Organizational Impact*. We postulate that the results of hypothesis 4, 5, and 6 that found significant, positive relationships between the dimensions of *Individual Impact*, *Workgroup Impact*, and *Organizational Impact* when assessed in that order lends credence to the notion that the impact of IS might follow such a nomological flow (or order) as implied by other researchers (Myers et al., 1996, 1997).

6.1. Implications for research and practice

This research has implications for IS success, in general and ERP system success in particular. While the original D&M (1992) IS success model has been extensively tested in the literature, not many have used the DeLone and McLean's (1992) schema and other related conceptualizations to assess the success or effectiveness of ERP applications in business organizations. Thus, our research effort may entice other ERP researchers to consider this area of study. With more and more emerging studies in this particular area, it is reasonable to expect that adopting organizations will be better informed as to how to improve the effectiveness of their ERP packages in their respective contexts.

In particular, our research effort extends an ERP system success model proposed by Sedera and colleagues, and we further contributed to the literature by testing the interrelationships among its constructs or dimensions. To some extent, our study has responded to the call made by DeLone and McLean (1992, 2003), Sabherwal et al. (2006), and Petter et al. (2008) for studies examining the relationships among constructs that are employed to examine the effectiveness of IS to be commissioned. By specifically using the Sedera and colleague ERP success framework as a base, we have responded to the call made by Petter et al. (2008) for IS researchers to use that model (or an extended version of it) to enhance theory development in this area.

Our study serves to enrich the theory of IS success evaluation. In many respects, our research offers support for the findings reported in related studies with regard to the nature of relationships among the dimensions of IS success (these have been dealt with above). It is safe to suggest that such related findings strengthen the domain of IS success evaluation, in general. To the extent that ERP success is viewed as a multidimensional, interindependent, and inter-related schema, our research and its findings emphasized this notion. Importantly, our study provides empirical support for the D&M (1992) IS success conceptualization as being a casual model. In that respect, our data provides empirical support, which shows that an ERP application will be effective or successful for an adopting organization if the system quality, its informational output quality (though unsupported by this data), and the quality of the external service providers are perceived to be high. It is these aforementioned quality issues which directly impact individuals using the application. Subsequently, the individuals' work-groups and other units within that organization, as well as the entire business will ultimately be positively impacted.

To some extent, our research data offer nomological validity to the conceptualization of IS success model. According to Churchill (1995, p. 538), an instrument or model has nomological validity if it "behaves as expected with respect to some other constructs to which it is theoretically related." A large amount of the variance in the *Organizational Impact* in our research study was explained by the other ERP success dimensions.

Indeed, our respecified ERP success measurement model strikes a balance between comprehensiveness and parsimony. We added two new dimensions to the Sedera and colleague's model, which we argued are pertinent for the evaluation of ERP success in latter stages of the system life cycle for adopting organizations. Prior research mainly uses the original D&M IS success model to assess the effectiveness of IS without paying due attention to the attributes and characteristics of the technology. Our line of argument, as well as our approach may benefit other IS success researchers. It is important to note that this research is among a few studies which provide empirical evaluations of IS (in this instance with ERP systems) at the organizational level. Petter et al. (2008) have noted the dearth of such studies in the literature.

Our research has useful implications for practitioners as well. First, as this study is partly motivated by the need to provide managers with guidelines for assessing the success of their ERP software, we hope that our comprehensive list of ERP success dimensions and measures could be used as a diagnostic tool in success evaluations of such packages. The identified dimensions/measures used in this study can be used to assess the effectiveness of the system for the individual, their work unit, and the entire organization. In brief, the respecified ERP success measurement framework is simple yet comprehensive. If the proposed measurement evaluation tool is utilized appropriately and periodically, management could use it to obtain timely feedback about the "success" of the ERP package in their setups. Corrective actions and measures aimed at improving less than favorable aspects of the package could then be taken to address such concerns.

Second, ERP practitioners' attention is drawn to the fact that *Information Quality* attributes may be problematic in the evaluation of the success of the software application. Put differently, *Information Quality* may not serve as a good measure of ERP success; instead a useful starting point for success assessment (and for realizing success with the software) should be on the attributes related to *System Quality* and *Service Quality*. However, our suggestion on this issue cannot be taken as the final word on the matter. More studies in the area are needed to reify or debunk our claim. Third, it may seem intuitive for management to utilize the "Quality" constructs and their measures to assess situations with ERP software during the early periods preceding acquisition and use the "Impact" construct (and their items) for latter periods when the impact of ERP to the workgroups and the entire organization are to be assessed. When used in such a manner, an ERP system success framework such as the one proposed herein could help in identifying aspects requiring further attention and actions.

Fourth, this study implies that for a clear picture of the effectiveness of ERP in the adopting firm to be understood, management must accommodate several levels of analysis, including the sub-unit level. Fifth, the attention of practitioners is drawn to post-implementation ERP system success issues, which we argued should not be conflated with ERP implementation CSF. Sixth, as the relationship between *Service Quality* and *Individual Impact* indicated the least strength statistically in our model, this information might be interpreted to mean that there is a need for ERP service providers to pay more attention to employees' operational needs vis-à-vis the package. Seventh, our study highlights the need for ERP providers to improve the informational quality of their products. If such is possible, it is likely that the overall satisfaction levels and benefits that individuals and adopting organizations derive from their ERP investments may further be enhanced.

6.2. Limitations and future research directions

We acknowledge that there are inherent limitations to this research. First, although common method bias was not problematic for our data, it is still possible that respondents may be subject to a *halo effect* – this refers to an increased likelihood that statistically significant results are obtained from respondents whose overall impression of ERP applications in their organization are already high. In other words, those with vested interests in the package will offer favorable responses. Second, we surveyed firms using

"ERP systems" defined by their generic functionality. It is likely that differences may become noticeable when controls for ERP types are used. Our data with a variety of ERP packages might have been impacted for this reasoning. Third, we used subjective and perceptual measures in this study; it is likely that an objective measure of ERP success (i.e., profit and productivity indicators) might yield a different result from ours. Fourth, the views of private sector organizations are discussed herein; thus, generalizing our findings to all contexts should be done with caution. Fifth, the views of lower level employees who actually tend to use ERP systems more than their senior counterparts may differ considerably from those presented in our study. Accordingly, our results should be interpreted in the context of such a limitation. Sixth, findings from this study may lack universal support as our data came from only one region of the world: technologically advanced world. It is possible that data obtained from other parts including the developing world – with differing cultural orientations – may be different what was reported and discussed in this article.

More studies are expected in this area of research. For example, this present study can be replicated in other settings. It is impossible to establish the validity of findings on the basis of a single study. Further testing of the proposed model should seek to establish its validity in other contexts. Our data is cross-sectional in nature; future studies could consider using longitudinal data to facilitate insight regarding ERP success evaluation over its life cycle in adopting organizations. It is possible that our proposed ERP success measurement model could benefit from further refinements; some aspects of our results require additional work. The relationship between *Information Quality* and *Individual Impact*, which is at odds with the success evaluation conceptualization in the extant IS literature, clearly requires further investigation. Another fruitful avenue for future study would be to establish and confirm the direction of flow through *Workgroup Impact* in other enterprise systems such as Customer Relationship Management (CRM) and Supply Chain Management (SCM). Above all, future research should make an attempt to address some of the limitations noted in this study.

7. Conclusion

We proposed an extension to an evaluation framework for assessing the success of ERP packages in adopting organizations. The respecified ERP success measurement model drew largely from prior schemas in the extant IS literature and our extended model was found to have a reasonable explanatory and predictive power. We contend that the effectiveness of ERP systems in adopting organizations cannot be gauged from single proxy construct, i.e., user satisfaction. Rather, it is worth the while for ERP success evaluation to utilize multidimensional indicators of success. Our ERP system success measurement conceptualization took into account the nature of the technology under focus.

Also, our research provides empirical analysis in support of the direction of flow in the D&M (1992) IS success framework as well as their relationships. In that regard, five out of the six hypothesized paths in our nomological network were found to have statistical significance. Our results support findings and observations in prior IS studies. As this endeavor is among the few to discuss ERP system success with organizational level data, our effort enriches the IS literature accordingly. This current research work consolidates the IS success evaluation theory and could serve as a base for future inquires. As well, practitioners' understanding of ERP success assessment is further enhanced through this research. It is however not claimed herein that our framework is the final word for success measurement or evaluation for ERP systems in adopting organizations; more work is expected.

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Contributions. All four authors were involved in data collection in the two countries. Dr. Princely Ifinedo designed the research questionnaire and wrote the paper.

Appendix A

Summary of the measurement scales.

Measurement item	Item loading
System quality: Cronbach's $\alpha = 0.801$; composite reliability = 0.856	
Our ERP has accurate data	0.563*
Our ERP is flexible	0.663
Our ERP is easy to use	0.683
Our ERP is easy to learn	0.518
Our ERP is reliable	0.667
Our ERP allows data integration	0.765
Our ERP is efficient	0.815
Our ERP allows for customization	0.546*
Our ERP database content is good	0.283*
Our ERP allows for integration with other IT systems	0.653
Our ERP meets users' requirements	0.539*
Information quality: Cronbach's $\alpha = 0.857$; composite reliability = 0.891	
Our ERP has timely information	−0.168*
The information on our ERP is understandable	0.722
The information on our ERP is important	0.625
The information on our ERP is brief/concise	0.728
The information on our ERP is relevant	0.812
The information on our ERP is usable	0.857
The information on our ERP is available	0.805
Service quality: Cronbach's $\alpha = 0.842$; composite reliability = 0.884	
Our ERP provides prompt information to users	0.774
Our ERP system has a good interface	0.584
Our ERP has visually appealing features	0.656
Our ERP provides the right solution to requests	0.781
Our ERP service provider is dependable	0.790
Our ERP service provider has up-to-date facilities	0.542*
Our ERP service provider is experienced and provides quality training and services	0.749
Individual impact: Cronbach's $\alpha = 0.815$; composite reliability = 0.871	
Our ERP enhances individual creativity	0.506*
Our ERP enhances organizational learning and recall for individual worker	0.747
Our ERP improves individual productivity	0.802
Our ERP is beneficial for individual's tasks	0.669
Our ERP enhances higher-quality of decision making	0.835
Our ERP saves time for individual tasks/duties	0.731

Appendix A (*continued*)

Measurement item	Item loading
Workgroup impact: Cronbach's $\alpha = 0.852$; composite reliability = 0.887	
Our ERP helps to improve workers' participation in the organization	0.649
Our ERP improves organizational-wide communication	0.712
Our ERP improves inter-departmental coordination	0.793
Our ERP create a sense of responsibility	0.732
Our ERP improves the efficiency of sub-units in the organization	0.735
Our ERP improves work-groups productivity	0.727
Our ERP enhances solution effectiveness	0.767
Organizational impact: Cronbach's $\alpha = 0.857$; composite reliability = 0.894	
Our ERP reduces organizational costs	0.750
Our ERP improves overall productivity	0.838
Our ERP enables e-business/e-commerce	0.533*
Our ERP provides us with competitive advantage	0.800
Our ERP increases customer service/satisfaction	0.724
Our ERP facilitates business process change	0.592*
Our ERP supports decision making	0.707
Our ERP allows for better use of organizational data resource	0.765

Note: The measurement items marked with asterisks (*) were dropped from subsequent analysis.

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