INTERACTIONS BETWEEN ORGANIZATIONAL SIZE, CULTURE, AND STRUCTURE AND SOME IT FACTORS IN THE CONTEXT OF ERP SUCCESS ASSESSMENT: AN EXPLORATORY INVESTIGATION

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ABSTRACT

Enterprise Resource Planning (ERP) systems are packaged information technology (IT) suites that are increasingly becoming the price of entry for running a business, and such systems are gaining popularity worldwide. Researchers have discussed their adoption and implementation. Few have investigated the impacts of *size*, *culture*, and *structure* of the adopting organization on ERP system success evaluations. There is also a dearth of research on the effects of organizational IT issues or factors such as *IT assets* and *resources* (i.e., the IT department's value, the IT department's size, and the sophistication of the in-house IT professionals, among others) on ERP systems success. To our knowledge no study has investigated the interactions between these organizational IT issues and other contingency factors. To fill this gap in research, we designed an exploratory study to investigate the impacts of the aforementioned factors in the context of ERP systems success evaluations. Rather than considering the impacts of the three contingency factors on ERP success assessment alone, we incorporated the interacting effects of a few organizational IT issues which were selected for illustration purposes. Surveys were conducted in Finland and Estonia — two small technologically advanced Northern European countries. We obtained empirical data from 62 respondents in 44 diverse, private, and industrial organizations in the two countries. Using the structural equation modeling technique to examine the relationships, our analysis confirmed six of the eight hypotheses formulated. The data revealed positive relationships between organizational size, structure, and culture, on the one hand and ERP systems success, on the other. Also, *IT resources* (comprising of measures such as the IS budget size and size of the IT department) as a moderator in the relationships between the main contingency factors and ERP success was found be significant. The implications of the findings for both practice and research are discussed, and fruitful areas for future research outlined.

Keywords: ERP success, size, culture, structure, firm, IT assets, IT resources, structural equation model

INTRODUCTION

Today, organizations worldwide adopt Enterprise Resource Planning (ERP) systems under the pressure of changing business environments rather than build their information systems (IS) in-house (Markus and Tanis, 2000; Matthys and Shorter, 2000; Zviran, et al., 2005). ERP systems are gaining popularity and have been described as the "price of entry for running a business" (Kumar and van Hillegersberg, 2000, p. 24). Essentially, an ERP is a complex business information technology (IT) package designed to integrate business processes and functions, and it is capable of presenting a holistic view of a business by permitting the sharing of common data and practices in a real-time environment (Davenport, 1998; 2000; Markus and Tanis, 2000). ERP systems are adopted for a variety of reasons, including replacement of legacy IT systems and customer service improvement (Davenport, 1998; 2000; Markus and Tanis, 2000; Mabert et al., 2003). There is no consensus on the benefits or impacts of ERP adoption (Mabert et al., 2003; Pyun, 2002). Negative and positive results have been reported in the IS literature and related trade press (META Group, 1999; Davenport, 1998; 2000; Al-Mashari and Zairi, 2000). Regardless, ERP continues to grow globally and according to AMR Research, the ERP market is to grow from US$47.8 billion in 2004 to US$64.8 billion by 2009 (AMR Research, 2005). It comes as no surprise, then, that much of the extant literature on ERP deals with issues relating to their adoption, implementation critical success factors (CSFs), and implementation methodologies (Bingi et al., 1999; Holland and Light, 1999; Esteves and Pastor, 2001; Ahituv et al. 2002; Hong and Kim, 2002). Few studies have empirically examined the impact of organizational contingencies such as size, culture, and structure on the one hand, and ERP system success, on the other. Likewise, studies discussing the impacts of organizational IT issues or factors, such as IT assets and resources on ERP systems are scarce.

Our study of the literature revealed only one study that examined the relationship between size and ERP systems success (Sedera et al., 2003a). Jones and Price (2001) and Morton and Hu (2004) discussed organizational culture and structure only at the conceptual level and limited their discourse to ERP *implementation* success, which is different in scope to our concept of ERP systems success. Our notion of ERP success refers to the utilization of such systems to achieve organizational goals (Hamilton and Chervany, 1981; DeLone and McLean, 1992; Scott, 1994; Grover et al., 1996; Gable et al., 2003). Our ERP success excludes the technical installations' success (Martin, 1998; Tan and Pan, 2002; Markus et al., 2000) wherein the measurement indicators include cost overruns, project management metrics, time estimate, etc. (Martin, 1998; Markus and Tanis, 2000; Hong and Kim, 2002). Literature discussing comparable themes of ERP systems success includes: Nelson and Somers, 2001; Tan and Pan, 2002; Gable et al., 2003; Sedera et al., 2003a, b; Wu and Wang, 2005. Unfortunately, none of the foregoing researchers investigated the impact of contingency factors as antecedents to ERP systems success as we intend to do in this paper; rather, they reported the development of ERP success frameworks and organizational users' perceptions of ERP success.

Particularly worrisome is the imbalance in the ERP literature. In January 2006, we searched the database (eLibrary) of the Association for Information Systems (AIS) containing peer-reviewed articles and panel discussions for 5 major conferences, ICIS, AMCIS, ECIS, PACIS, and BLED, for a ten-year period between 1995-2005. Our search word "ERP" yielded 397 entries, of which 49% (195) were for works related to ERP "implementation" and "adoption". A repeat of the process with other popular databases (i.e., ABI Inform: ProQuest Direct, ScienceDirect, and Emerald) yielded comparable results. Indeed, some commentators (e.g., Al-Mashari, 2003) have called for more studies into other aspects of ERP apart from the putative issues of adoption, CSFs, and implementation methodologies. This study is motivated in part by such calls.

Researchers (e.g., Davenport, 1998; 2000; Al-Mashari and Zairi, 2000; Markus and Tanis, 2000; Willcocks and Sykes, 2000; Hong and Kim, 2002; Morton and Hu, 2004) have emphasized the relevance of contingency factors, such as organizational culture, structure, and organizational IT factors in both ERP implementation and benefit (or success) realization. For example, Davenport (1998; 2000) notes that adopting firms must be aware of their existing culture and structure when adopting ERP packages, and the author cites examples of companies (e.g., Dell Computers) that either failed with their implementation processes or benefit realization when these salient contingency factors were downplayed or ignored. Specifically, Davenport (1998, p. 122) states, "An enterprise system [ERP], by its very nature, imposes its own logic on a company's strategy, organization, and culture". As more companies adopt ERP, the implementation techniques seem to be improving with the accumulated knowledge (Martin, 1998; Davenport, 1998; 2000; Willcocks and Sykes, 2000). Thus, success on this front may be increasing accordingly (Al-Mashari and Zairi, 2000; Markus et al., 2000). However, the overall ERP success rate, at the same time, is not increasing. This has led researchers to suggest that perhaps contingency factors such as organizational culture, structure, management style, or size could be the culprits. For example, Swan et al. (1999) argued that the high failure rate associated with ERP could be attributable to the differences between the organizational culture of the adopting firms and that of the ERP providers. Evidence in support of the pertinence of contingency factors is provided in other studies (Raymond, 1985; Krumbholz et al, 2000; Krumbholz and Maiden, 2001; Soh et al., 2000; Davenport, 2000). Again, most of these researchers focused on ERP implementation (except Raymond, which discussed firm size and IS success).

Thus, the dearth of research on other aspects of ERP studies especially in areas relating to the impact of organizational contextual or contingency factors at the post-implementation phase is the motivation for this research. Our primary objective is to examine the relationships or impact of the contingencies (i.e., size, structure, and culture on ERP success). Nevertheless, this paper does not seek to consider the contingency factors in isolation (Weill and Olson, 1989; Gefen et al., 2000). Rather, this research is designed to avoid one of the defects of the Contingency Theory or approach; namely, the assumption of a "deterministic model" (Weill and Olson, 1989). Thus, we examine the interactions between the main contingencies and organizational IT issues, including IT assets and resources. It is critical to consider the moderating roles or interacting effects of organizational IT factors on ERP success assessment because firms that have been successful with the software are those that have accepted that ERP acquisition is not only a business matter but a technological/technical matter as well (Davenport, 2000; Willcocks and Sykes, 2000). It is hoped that this approach will provide useful insights, and that our conclusions will be beneficial to practitioners and researchers alike.

BACKGROUND

Contingency Theory and Approach

This study draws from the Contingency Theory developed by Lawrence and Lorsch (1967), which several researchers have modified (e.g., Kast and Rosenzweig, 1973; Venkatraman, 1989; Donaldson, 2001). Among them Donaldson (2001) developed the structural-contingency theory, and Venkatraman (1989) elaborated on the conceptualization of "fit". In essence, the Contingency Theory posits that organizational effectiveness can result from the matching of organizational characteristics to contingency factors. According to Donaldson (2001, p. 7), "any variable that moderates the effect of an organizational characteristic on organizational performance" is a contingency. He also noted, "At the abstract level, the contingency approach says that the effect of one variable on another depends upon some third variable. . . ." (p. 5). Weill and Olson (1989) note that IS researchers have traditionally assumed a link between IS success and organizational performance; thus the conceptualization as used in our study is consistent with such traditions. That said, Weill and Olson (1989) listed strategy, structure, size, environment, technology, individual, and task as the six commonly used contingencies in the literature, and they noted that organizational performance, in many respects, is often modeled as the dependent variable. However, this study focuses on ERP success, which is comparable to but different from organizational performance. Other researchers (e.g., Scott, 1994) have studied the relationships between IS effectiveness (success) and organizational performance. However, there is a salient difference between the two conceptualizations; namely, organizational performance is often assessed by monetary returns to the organization (Scott, 1994; Grover et al., 1996) while ERP success, as we clarified above, is concerned with the enhancement of organizational effectiveness through the system's acquisition (Hamilton and Chervany, 1981; DeLone and McLean, 1992; Gable et al., 2003).

The suggested operational measures for IS success and organizational contextual factors developed by Ein-Dor and Segev (1978) include some of the contingencies listed by Weill and Olson (1989). As noted above, in this paper, we investigate the impact of only three main contingency factors for illustration purposes. Before discussing each of the contingencies as used in this paper, it is important to emphasize some of the assumptions in the Contingency Theory or approach that have recently come under scrutiny and criticism (Schoonhoven, 1981; Weill and Olson, 1989; Venkatraman, 1989). In particular, Weill and Olson (1989) discuss the shortcomings of the theory by suggesting that researchers tend to use financial measures to evaluate effectiveness. They also expressed dissatisfaction with the use of models that are deterministic. Overall, Weill and Olson (1989) provide guidelines for researchers wishing to use the theory or approach. In brief, in this study, financial measures are not operationalized as the indicator of ERP system success, and we "appreciate the interactions of the various aspects of MIS" (Ibid, p. 79). Essentially, our research model includes relationships designed to improve the causal explanation by avoiding a "deterministic model" (i.e., only the arrows representing a required association are shown and the

effects of other factors are ignored) (Weill and Olson, 1989). The study by Hong and Kim (2002) provides an example of an ERP study using the contingency approach where a non-deterministic model is used to enhance insights. Finally, Venkatraman (1989) assert that on many occasions, researchers do not verbalize or use the appropriate statistical analysis for their studies when using the contingency approach. He provides six paradigms (including mediation, moderation, etc) to help researchers overcome those shortcomings. This paper uses moderation in light of the interactions among some of variables operationalized.

Organization or Firm Size

Although many researchers have described firm size differently (see Laukkanen et al., 2005), they seem to agree that firm size can be assessed using employee workforce, and/or annual turnover/sales (Ein-Dor and Segev, 1978). Accordingly, the European Commission (EC, 2003) defines small and medium-sized companies as follows. Firms with less than 250 employees and an annual turnover of less than €50 million are medium-sized firms. Those with less than 50 employees and an annual turnover of less than €10 million are small firms. Firms not included in the foregoing classifications, and with higher values for these two factors, are labeled "large firms" (Laukkanen et al., 2005).

That said, the literature indicates that firm size is associated with IS success (Raymond, 1985). Laukkanen et al. (2005, p. 7) emphatically stated, "Company size, indeed, does matter in ERP adoption". Bernroider and Koch (2001) concluded the ERP selection process is different among firms depending on size, and that smaller firms tend to associate problems with implementation costs (Buonanno et al., 2005). Laukkanen et al.'s (2005) findings suggest that small companies experience more knowledge constraints than larger firms during ERP adoption. Mabert et al. (2003) noted that ERP benefits differ according to firm size. Sedera et al. (2003a), investigating a comparable theme to our study, provided evidence to Mabert et al's study with the confirmation that larger firms experience more ERP benefits when compared to smaller firms. However, other studies (e.g., Gremillion, 1984) suggest insignificant relationships between size and IS use (taken as a surrogate of IS success).

Organizational Culture

Organizational culture can be viewed from different perspectives. According to Kanungo et al. (2001, p.32), "The multiplicity of terms and concepts associated with organizational culture has contributed to conceptualizing culture in different ways." However, the work of Schein (1985) and Hofstede (1984) are among the most cited. According to the former, culture is "a pattern of basic assumptions — invented, discovered, or developed by a given group as it learns to cope with its problems of external adaptation and internal integration — that have worked well enough to be considered valid. . . ." (p. 9). Likewise, Hofstede (1984) assert that culture is a way things are done in the business and shared perceptions, beliefs, symbols, rites and rituals, and myths may be "taken for granted" in an organization. Following these descriptions, the existing culture in a company may have a bearing on the way people within it work, deal with others, and adopt and use technology (Krumbholz and Maiden, 2001). Schein (1985) describe how organizations can be differentiated using some dimensions. These include shared meaning, and embedded skills, among others. Kanungo et al. (2001) also provide a comprehensive list of organizational culture assessment instruments. Our study of the literature for these instruments revealed that shared beliefs and collaborative, supportive, and cooperative attributes are pervasive. As noted above, organizational culture has many views. Here, we concentrated on the aspects relating to shared norms and values, and supportive, collaborative, and cooperative behaviors. ERP implementation success, in some respects, is often reported as related to these issues (Bingi et al., 1999; Esteves and Pastor, 2001).

As indicated above, the significance of organizational culture in ERP studies has been noted in the literature. Many researchers (e.g., Krumbholz et al., 2000; Krumbholz and Maiden, 2001; Soh et al., 2000) have suggested that the core values in the corporate culture of adopting firms can cause mismatch problems during the ERP implementation process and for benefit realization from such systems (Davenport, 1998; 2000; Kappos, 2000; Jones and Price, 2001). Likewise, the overall success with ERP may also be enhanced if there is a match between the culture of the adopting firm and the underlying logic of the system (Davenport, 1998; 2000; Willcocks and Sykes, 2000; Kumar and van Hillegersberg, 2000).

Organizational Structure

The characteristics of organizational structure (also called organizational design) can be described in several ways (Mintzberg, 1980; Fry, 1982; Daft, 1998; Donaldson, 2001). According to Daft (1998, p. 15), "Structural dimensions provide labels to describe the internal characteristics of an organization. They create a basis for measuring and comparing organizations." Morton and Hu (2004) noted that commonly used structural dimensions include centralization, specialization, standardization, formalization, hierarchy levels, etc. Different researchers tend to use the dimensions based on research purposes. For example, Morton and Hu (2004) noted that Fry (1982) used centralization and formalization in assessing technology-structure relationships. Donaldson (2001) used centralization, specialization, standardization, and formalization in his Structural-Contingency Theory. Mintzberg (1980) classified organizations into five main types, namely, simple form, machine-bureaucracy, professional bureaucracy, divisionalized form, and adhocracy. This typology describes each of the five structures using the aforementioned structural dimensions. Importantly, in reality, organizations rarely exist in the distinctive pure forms articulated by Mintzberg (Morton and Hu, 2004). Our pilot test using them was subsequently revised to enhance understandability by our participants. Here, we focused on the following three dimensions: centralization, specialization, and formalization, which we believed are adequate for assessing technology-structure relationships (Fry, 1982; Donaldson, 2001).

Centralization refers to the decision-making hierarchy in the organization. When decisions are kept at the top, an organization is centralized, whereas in decentralized organizations, decisions are delegated to lower organizational levels (Daft, 1998). ERP systems support command and control structure, which may allow those at the top of organizational hierarchy profit the most (Davenport, 1998; 2000; Abdinnour-Helm et al., 2003; Amoako-Gyampah, 2004). According to Daft (1998), specialization is the extent to which tasks are subdivided into separate jobs in an organization. If specialization is extensive, it is likely that each worker performs a narrow range of work. Formalization is the degree to which rules and procedures are clearly documented and are known to all employees. Lee and Kim (1992) discuss the rela-

tionship between formalization in IS development and IS success. It is known that ERP systems require disciplined task behavior among workers in an organization (Strong et al., 2001), and ERP might be more applicable for firms having distinct and specialized functions or tasks. One might argue that the numerous "best practices", modules, and procedures in an ERP system could be exploited effectively were such tasks to be extensively specialized (Davenport, 1998; 2000; Strong et al., 2001).

INTERACTING VARIABLES: ORGANIZATIONAL IT FACTORS OR ISSUES

As previously indicated, the effects or impacts of organizational IT factors in the assessment of ERP success are critical. This is seen in the case of firms that have been successful with the software after accepting the business-technological imperatives of an ERP acquisition (Davenport, 2000; Willcocks and Sykes, 2000). Here, for illustration purposes, we highlight the interacting effects of IT assets and resources, which were created from such measures as the size and value of IT department, IT resources (budget size), and in-house IT professionals skills in the organization, on the main contingencies. Essentially, our use of factor analysis (see below) permitted us to group measures that loaded together under new names. For example, both IT department' value and skills/sophistication of in-house IT staff measures loaded together, and were referred to as "IT assets". Next, we briefly discuss each of the organizational IT contingencies.

IT Assets: IT Staff Expertise and the Value of the IT Department

Lee and Lee (2004) used the term "IT assets" in describing the IT infrastructural support consisting of highly competent human IT assets and strong relationships between IT and business (in other words, the value of IT to the business). The IT staff's quality (i.e., knowledge of technological changes and up-to-date skills) is cited among the important factors required for IT systems success in general and for ERP implementation success in particular (Essex et al., 1998; Esteves and Pastor, 2001; Lee and Lee, 2004). Several ERP studies (e.g., Holland and Light, 1999; Esteves and Pastor, 2001; Markus and Tanis, 2000; Willcocks and Sykes, 2000; Lee and Lee, 2004) have suggested that the knowledge base or expertise of the in-house IT professionals must be adequate to ensure success with ERP implementation. In a recent study Duplaga and Astani (2003) found that "Lack of in-house expertise in ERP" ranked second on a list of 13 key ERP implementation factors for 30 US manufacturing firms that they interviewed. Empirical evidence suggests that IT systems are more likely to succeed in organizations where general IT skills and relevant in-house IT expertise exist (Igbaria, 1990; Lee and Lee, 2004).

There is ongoing skepticism regarding the value that IT departments give to their organization (Benjamin et al., 1985; Ward and Peppard, 1999; Willcocks and Sykes, 2000), this can be attributed to two types of reasoning: 1) the inability of the IT department to deliver or appreciate business issues, 2) cultural gaps between IT personnel and other organizational members (Ward and Peppard, 1999; Willcocks and Sykes, 2000). Empirical evidence from the works of Willcocks and Sykes (2000) indicate that ERP implementation tends to be more successful when IT departments are rated highly and are consulted during ERP implementation than when they are sidelined. Commenting on ERP adaptation strategies, Ho et al. (2004, p. 247) wrote the "MIS [IT] department has changed from systems development to IT knowledge consultation." However, the reality in the context of ERP adoption is that IT departments tend to have less important roles in ERP initiatives compared to other departments (Willcocks and Sykes, 2000).

IT Resources: Size of the IT Department and IT Budget's Size

The levels of IT resources available to a firm can be gauged through its IT department's size and the budgets allocated to that department. The IT department initially locates itself within other departments, but as the IT unit matures or the organization becomes wealthier, it eventually becomes autonomous (Choe, 1996; Shields, 2001). Furthermore, as IT systems have become increasingly valuable to organizations, the IT department has morphed from its traditional role of supporting back-office operations to offering competitive advantages (Benjamin et al., 1985; Raghunathan, 1992). In brief, larger firms tend to have specialized IT departments, usually with a sizeable number of workers. This may not be the case, however, with small firms due to lacking resources (Cragg and King, 1993; Laukkanen et al., 2005).

Ein-Dor and Segev (1978, p. 1070) posit that "budgeting of sufficient resources increases the likelihood of MIS success". However, Raymond (1990) found no evidence in support of the proposition. ERP adoption requires huge sums of money, and evidence tends to support the view that larger firms have more resources and are capable of allocating resources to IT issues, including software maintenance and upgrades, compared to smaller firms (Cragg and King, 1993; Bernroider and Koch, 2001; Laukkanen et al., 2005). Hunton et al. (2003) suggested that smaller firms possess fewer resources and are less able to attract resources compared to larger firms, "thus, large firms can more easily absorb and withstand ERP implementation costs (p. 170).

ERP SYSTEMS SUCCESS MEASUREMENT MODEL

Studies on ERP systems success assessment in the IS literature are beginning to emerge (Gable et al., 2003; Sedera and Gable, 2004). These researchers draw from the IS success evaluation literature (e.g., DeLone and McLean, 1992). The DeLone and McLean (D&M) IS success model is widely used and cited (Ballantine et al., 1997). With regard to ERP systems success measurement, Gable and colleagues developed an additive model that redefines the dimensions in the original D&M IS success model. Gable and colleagues eliminated (through multi-stage data collection and statistical analysis) the *Use* and *User satisfaction* dimensions. Arguments against dropping them are also available in Saarinen (1996) and Seddon (1997). The retained ERP success dimensions in Gable and colleagues' model are *System Quality* (SQ), *Information Quality* (IQ), *Individual* Impact (II), and *Organizational Impact* (OI). These four were modeled to form an overarching construct labeled ERP system success (see Gable et al., 2003; Sedera et al., 2003a). Ifinedo (2006a) proposed an extended ERP systems success measurement model. Through literature reviews and case interviews, two relevant dimensions not included in the Gable and colleagues model were incorporated, namely, *Vendor/Consultant quality* (VQ) and *Workgroup Impact* (WI) dimensions.

Among others, Rousseau (1979) and Bakos (1987) argued that researchers should consider assessing the impact of IT from different levels, including the workgroup level. Myers et al. (1996), heeding the call, incorporated the *Workgroup Impact* (WI) dimension to the DeLone and McLean model. Importantly, our notion of "workgroup" encompasses sub-units and/or functional departments of an organization. We contend that the underlying philosophy of ERP systems (see, Davenport, 1998, 2000; Markus and Tanis, 2000) lend support to Myers et al.'s conceptualization of IS success measurement. ERP systems are usually acquired to enhance efficient cross-functional operations within the adopting organization. Importantly, "interdepartmental cooperation" and "interdepartmental communication" ranked 3rd. and 6th. respectively in a study of 22 critical success factors (CSFs) of ERP implementation by Akkermans and van Helden (2002). Other ERP CSFs studies have produced comparable analyses (Esteves and Pastor, 2001).

Vendor/Consultant Quality (VQ) is also incorporated into the Gable and colleagues' model. Our case study in seven case companies in Finland and Estonia revealed that the ERP adopting firms that we interviewed tend to associate the overall success of their software with the quality of services, relationships, and so forth received from the system's vendors and consultants (Ifinedo, 2005). Indeed, Markus and Tanis (2000) highlighted "dependence on vendors" as a key issue in ERP implementations that differentiate these systems from other IT implementations. Additionally, our study benefited from Ballantine et al.'s (1997) 3-D model of IS success where *technical* development was seen as an important dimension. More importantly, a recent work by Wu and Wang (2005) discussing ERP systems also recognizes the relevance measures relating to the providers (e.g., suppliers, vendors, and consultants) as success measures for the software. Importantly, we grouped both vendors and consultants together because they represent an external source of expertise to the organization regarding ERP implementation. Sedera et al. (2003b, p. 1411) found that "consultant and vendor items loaded together yielding a new factor named external knowledge player."

The extended ERP success measurement model is illustrated in Figure 1. Full discussion on the framework is available elsewhere in (Ifinedo, 2006a), where each dimension of success was represented by differing numbers of measures (i.e., there were 45 measures in total). For the purposes of this study, we chose an equal number (i.e., five) of measures for each dimension. The Vendor/Consultant Quality had five measures in Ifinedo, (2006a). In short, the 30 ERP success measures used in this study compare with 45 measures in Ifinedo (2006a) in terms of reliability (see Ifinedo, 2006a, and Appendix1), and also compares with the 27 ERP success measures used in other studies (e.g., Sedera et al., 2004). The 30 measures chosen from the available 45 measures were the ones that yielded the most favorable loadings on PLS Graph 3.0 (see discussions below), and had better communalities in a Principal Component Analysis compared to similar measures for each dimension (Hair et al., 1998).

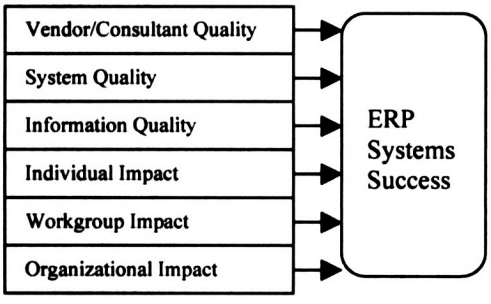

Figure 1. The Extended ERP Systems Success Measurement Model

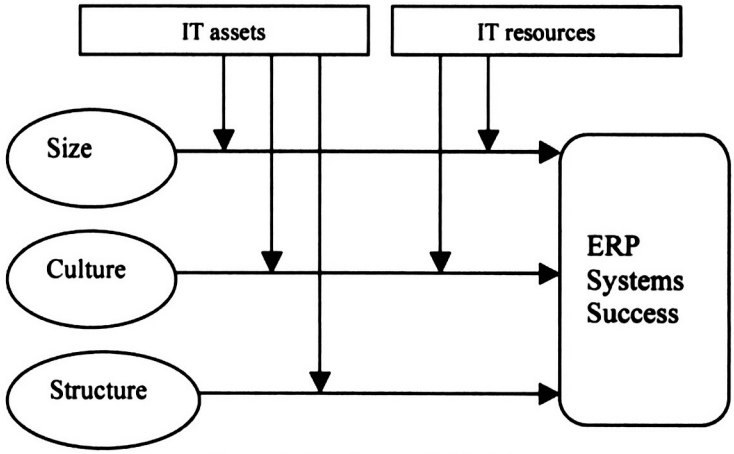

Figure 2. The Research Model

STATEMENTS OF HYPOTHESES

Based on the discussion presented in foregoing sections, we developed our research model in which the three main contingency factors and their interactions with the organizational IT factors or issues are hypothesized (see Figure 2). The statements of hypotheses are presented below.

As discussed, the size of a firm may have a bearing on the way it assesses the success of its ERP software (Bernroider and Koch, 2001; Buonanno et al., 2005; Laukkanen et al., 2005). For example, studies (e.g., Mabert et al., 2003; Sedera et al., 2003a) have shown that larger firms experience more ERP benefits compared to smaller firms perhaps because of the availability of resources (Hunton et al., 2003). Thus, we hypothesize:

H1a: There would be a relationship between firm size and ERP success.

ERP systems implementations, to some extents, benefit from the supporting assistance provided by in-house IT professionals (Willcocks and Sykes, 2000; Davenport, 2000; Markus and Tanis, 2000), and it is likely that bigger firms are able to house larger IT departments (Choe, 1996; Shields, 2001; Hunton et al., 2003). It is important to clarify that the sorts of skills required for an ERP implementation are different from other IT systems implementations (Markus and Tanis, 2000); nonetheless, it may be reasonable to suggest that firms with larger IT departments might have increased their prospects of having people with relevant expertise that could benefit their ERP acquisition. Furthermore, as the members of the organization recognize the roles that their IT department plays in ERP initiatives, the value of the IT department increases, and so will the overall success with the system. It is safe to expect larger firms possessing more IT assets to experience higher levels of success with their software than small firms. Therefore, we hypothesize:

H1b: The relationship between firm size and ERP success will be moderated by IT assets, such that success will be higher in larger firms.

A relationship exists between the financial resources available to a firm and how it evaluates its IS success (Ein-Dor and Segev, 1978; Raymond, 1985). It is known that small-sized firms possessing fewer resources than larger firms tend to have constraints relating to resource allocation (Cragg and King, 1993; Hunton et al., 2003; Laukkanen et al., 2005). ERP acquisitions are costly because resources must be continually kept back for maintenance and upgrades (Davenport, 2000). As would be expected, bigger IT budgets are more likely to be available to larger firms (Hunton et al., 2003; Laukkanen et al., 2005). Thus, it may be reasonable to suggest that the bigger the size of IT budget in an ERP adopting firm the better, since ERP systems success may increase with bigger IT budgets. Therefore we hypothesize:

H1c: The relationship between firm size and ERP success will be moderated by IT resources, such that success will be higher in larger firms.

Organizational culture is related to how the overall success of an ERP system is perceived in adopting organizations (Swan et al., 1999; Krumbholz et al., 2000; Soh et al., 2000). This is because employees who are used to doing things certain ways because of shared and enforced beliefs may have to accommodate the change that ERP imposes to enhance success with their software (Davenport, 2000; Krumbholz and Maiden, 2001). Further, evidence supports the view that the adoption of an ERP often brings about changes in organizational culture and intra-organizational functioning (Swan et al., 1999; Davenport, 2000; Krumbholz and Maiden, 2001; Strong et al., 2001; Lee and Lee, 2004). In addition, cultural attributes such as cooperation, collaboration and consensus are important ingredients required for success to be achieved in the course of adopting an ERP system (Willcocks and Sykes, 2000; Davenport, 2000; Markus and Tanis, 2000). For example, Jones and Price (2001) stated "organizational members must collaborate and share their knowledge as a team to successfully bring about the changes in the business required to realize long-term ERP benefits" (p. 551). Against this backdrop, we hypothesize:

H2a: A positive relationship exists between an organizational culture that is conducive to ERP adoption and ERP success.

The success of an IT system may depend on how organizational members view it. In organizations where cultural gaps between the IT department/personnel and others is less emphasized, the IT department is more likely to be valued, and IT systems in such organizations may be more successful than in firms having a less favorable perception of the IT department (Raymond, 1985; Ward and Peppard, 1999; Willcocks and Sykes, 2000). Similarly, in organizations where the employees (IT staff and others) have the necessary skills and expertise (Igbaria, 1990; Essex et al., 1998; Willcocks and Sykes, 2000; Duplaga and Astani, 2003; Lee and Lee, 2004) it is reasonable to suggest that ERP success will be higher compared to where such expertise is lacking. Thus, we formulate the following hypothesis:

H2b: Organizational culture will influence ERP success, such that success will be higher in firms with higher IT assets.

Studies on the allocation of resources in organizations have shown that some organizations have cultures that favor the disbursement of sufficient resources to the IT function whereas others may have less favorable views of such issues (see Schein, 1985; Segars and Grover, 1995; Johnson and Carrico, 1988; Ward and Peppard, 1996; Willcocks and Sykes, 2000; Krumbholz and Maiden, 2001). Against this backdrop, we predict that the existence of a positive organizational culture and higher levels of IT resources in an organization will augur well for the success of adopted IT systems, including ERP.

H2c: Organizational culture will influence ERP success, such that success will be higher in firms with higher IT resources.

The structure of an organization is considered to be very important when firms adopt ERP (Davenport, 1998; 2000). Organizations with high levels of centralization may favor ERP, in contrast to decentralized ones. ERP systems may be less useful in organizations where operation and tasks are not explicitly defined (Strong et al., 2001); this is because ERP enforces a disciplined behavior for adopting organizations in such a way that procedures need to be clear. We hypothesize:

H3a: A positive relationship exists between an organizational structure that is conducive to ERP adoption and ERP success.

As discussed in the preceding hypothesis, ERP systems are more useful, and would be more successful in organizations with the appropriate organizational dimensions than in organizations lacking such. We also argued that ERP systems success would be higher in firms where organizational members value their IT departments (and assuming those IT personnel possess some levels of expertise) as opposed to instances where such support is low or nonexistent (Willcocks and Sykes, 2000; Kim and Peterson, 2001). Put differently, the personnel in the IT department, because of their knowledge of technological and IT issues could be the best link or liaison between the adopting firm and the ERP provider. Thus, the in-house IT professionals may be able to assist other organizational members to efficiently and effectively use the acquired system to achieve the firm's objectives (e.g., using IT to support organizational procedures and tasks). Thus, we hypothesized:

H3b: Organizational structure will influence ERP success, such that success will be higher in firms with higher IT assets.

RESEARCH METHODOLOGY

This study was conducted in Finland and Estonia - two small neighboring technologically advanced Northern European countries. We sampled firms generated from local contacts and databases in both countries[1]. Firms were chosen by our ability to obtain contact addresses for key organizational personnel. We identified 350 and 120 firms from those databases in Finland and Estonia, respectively. Finnish companies began adopting ERP systems in

the late 1990s (van Everdingen et al., 2000), but the software is just beginning to spread to other parts of Europe, including Estonia (Clouther, 2005). Finland and Estonia share similar cultural values (Ifinedo, 2006b), and although our data comes from two different countries, we are assured of the homogenous nature of the sample on a major differentiator, cross-national cultural differences vis-à-vis ERP issues (see Soh et al., 2000). We concentrated on private organizations in the two countries because we believe the adoption of ERP systems might be higher there than in public sector organizations.

Since the unit of analysis of this study was at the firm level, only key organizational informants including senior and unit managers received a packet consisting of a cover letter, questionnaire, and a self-addressed, stamped envelope. These groups of respondents are among the most knowledgeable informants regarding ERP success in organizations (Gable et al., 2003). About sixty percent (60%) of the mailings included only one questionnaire; the rest (40%) of the mailings had two questionnaires. It was decided that multiple respondents from one organization would enhance the validity of the study as a common source bias would
be minimized. In addition, low response rates seen with IS research in the two countries as discussed in Nissinen (2002) prompted us to use this approach. In instances where we sent out two questionnaires, the recipients were instructed to give one of the questionnaires to an appropriate person within their organization. We encouraged the subjects to present views representative of their organization. To ensure that organization-wide perspectives are being reflected, we posed the questions in the questionnaire appropriately (please see the Appendix). To ensure data validity and reliability, four knowledgeable individuals (i.e., 2 IS faculty, 1 ERP consultant and 1 ERP managerial level user) completed the questionnaire before our mailing it, and their comments helped us improve its quality. We also noticed that for firms with more than one respondent, the responses on key issues were comparable; this enhances the validity of the responses from such firms as well as our data in general. To determine the minimum number of completed responses required for a meaningful analysis we used G*Power software (source: http://www.psycho.uni-duesseldorf.de/aap/projects/gpower/). By applying a high effect size of 0.80 (Cohen, 1988), a significant (alpha) level of .05, and power of 0.90, the software recommended an effective sample size of 56.

Instrument Development

The main contingencies in Figure 2 were assessed as follows. Organizational culture was operationalized using five statements adapted from Krumbholz and Maiden (2001). Examples include the following: "Employees work in collaboration with others" (See Table 2 for the others). We adapted three measures for the organizational structure construct from Daft (1998). These are: "In our organization, decision making is kept only at the top", "In our organization, rules and procedures are clearly documented and are known to all employees", and "In our organization, organizational tasks are divided into separate jobs." As explained, the dependent construct of ERP systems success was operationalized using 30 measures adapted from Gable at al. (2003) and (Ifinedo 2006a). All scales were based on a 7-point Likert ordinal scale ranging from *strongly disagree* (1) to *strongly agree* (7), and their reliability is high as assessed by Cronbach alphas that compares with recommended values (Nunnally, 1978) (Please see Appendix 1). Two indicators, workforce and turnover, were used to measure firm size following the guidelines provided by the European Commission (2003) and Laukkanen et al. (2005). 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). We asked what percentage of the annual budget is allocated to IT. The choices ranged from ≤ *2%* to *>40%* on 6-point Likert type scale. A wide rage of choices was provided because of the participation of IT firms who might be spending relatively higher sums compared to others. We assessed the value of the IT department using a 4-point Likert ranging from *not valued at all* (1) to *highly valued* (4). We also asked participants: How sophisticated or skilled are the IT staff/personnel in your firm? The issue was based on a 7-point Likert scale ranging from *not skilled, at all* (1) to *very skilled* (7).

Results

We analyzed our data using SPSS 13.0, and our respective response rates, excluding the unusable questionnaires received, was 29 firms (8.5%) for Finland, 15 firms (12.5%) for Estonia, and 44 (9.5%) combined for the two countries. We received 62 individual responses: 39 from Finland and 23 from Estonia. Our data, classified by hierarchy, comprised of 26 (42%) top-level management and 36 (58%) mid-level managers, and by occupation, 20 (32.3%) IT professionals/managers and 42 (67.7%) business managers. These groups of respondents are among the most knowledgeable informants regarding ERP success in organizations (Gable et al., 2003, Sedera et al., 2004). Their job titles included chief executive officer, chief information officer, chief accountant, IT manager and finance manager. There were 35 (56.5%) men and 27 (43.5%) women in our sample. On average, they had 9 years of work experience in their respective organizations. Of the respondents, 40% had college degrees, 20% had technical and other vocational education, and 43 (69.3%) were between 31 and 50 years old. Of the 62 respondents, 33.9% had SAP in their organizations, 14.5% had Movex, 9.6% had Scala, 8.1% had Hansa, and the remaining 33.9% had other mid-market ERP products, including Concorde, Nova, etc. The annual turnover of the firms in the sample ranged from €1 million to a little over €2 billion, with €19 million as the median. The workforce ranged from 10 to 13,000 employees, with a median of 120 employees. We received responses from a wide range of industries, including manufacturing, financial services, IT firms, pharmaceuticals, food processing, retail, and warehouse businesses.

It is difficult to establish whether the firms in our sample are representative of the population of firms in the two countries that have adopted ERP since no demographic information on ERP adoption is available as indicated above. However, our data is consistent with the study by Laukkanen et al. (2005) indicating that ERP adoption in Finland is higher in the retail and manufacturing sectors, and our earlier study (Ifinedo, 2005) suggested that SAP is the most common ERP software among large firms in Finland. Our informal discussions with ERP consultants in the two countries confirmed that small and medium-size firms in the region usually adopt mid-market ERP products (i.e., Movex, Scala, Hansa, etc.), as our data showed. Finally, using the procedure suggested by Armstrong and Overton (1977) to assess whether our respondents reflect the sampling frame of ERP adopting firms in the two countries, we compared early and late respondents in the study on key organizational characteristics such as size, in-

Table 1. Descriptive Statistics

Construct	Valid number	Number of measures	Mean	Std. dev.
Organizational culture	62	5	4.70	1.33
Organizational structure	62	3	4.49	1.43
ERP systems success	62	30	4.76	1.22
Skills/sophistication of the IT staff	62	1	5.23	1.18
Size of the IT department	60	1	2.32	1.48
Value of the IT department	60	1	3.21	0.813
	Number		Percent (%)	
IT budget size				
≤2%	28		45.2	
3-6%	16		25.8	
7-10%	3		4.8	
11-20%	3		4.8	
Missing	12		19.4	
Breakdown of Size (workforce)				
Small firm	15		24.2	
Medium-sized firm	25		40.3	
Large firm	22		35.5	
Breakdown of Size (annual turnover)				
Small firm	21		33.9	
Medium-sized firm	21		33.9	
Large firm	20		32.2	

Table 2.
Factor Analysis of the Interacting Organizational-IT issues

Measure	Factor 1	Factor 2
Skills/sophistication of the IT staff	.193	.840
Value of the IT department	.136	.862
Size of the IT department	.867	.173
IT budget size	.866	.160
Eigenvalue	2.09	0.96
% Cumulative variance	56.48	76.53

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 3 iterations.

dustry type, year of ERP adoption, and ERP type, among others (i.e., nonresponse bias). The results of the chi-square tests (significant at < 0.05) showed there were no significant differences along these key characteristics. Descriptive statistics of the research constructs are shown in Table 1.

DATA ANALYSIS

The research model shown in Figure 2 was assessed using PLS Graph 3.0. The PLS (Partial Least Squares) procedure is a latent structural equation modeling technique (Chin, 1998; 2000; Gefen et al., 2000). PLS uses a component-based approach to estimate structural models, and it places minimal demands on sample size. In addition, it is especially suitable for exploratory research focusing on explaining variance (Chin, 1998; Gefen et al., 2000). Given the foregoing, PLS seemed particularly relevant for this exploratory study that is limited by sample size. Further, unlike the traditional multiple regression analysis that is less efficient in assessing measurement errors PLS recognizes two components of a casual model, the measurement model and the structural model (Chin, 1998; 2000; Gefen et al., 2000). The measurement model consists of relationships among the conceptual factors of interest (the observed items or variables) and the measures underlying each construct, and it demonstrates the construct validity of the research instrument (how well the instrument measures what it purports to measure). The main criteria are the item loadings, convergent validity (composite reliability), and the discriminant validity. Fornell and Larcker (1981) and Chin (1998) note that individual item loadings and internal consistency values greater than 0.7 are adequate. Chin recommends that a confirmatory factor analysis should be conducted to refine the measure measurement model. We used SPSS 13.0 to extract 4 factors (see the factor analysis results in Appendix 2). This might be interpreted to mean that the four constructs are adequate as they account for 52% of the variance in the analysis, and each indicator loads fairly well under its assigned construct. In addition, we performed a separate factors analysis for the interacting effects to have insight on how each measure loaded in relation to the others; the results as shown in Table 2 indicate that the items used to denote the higher order factors of IT assets and IT resources load under its assigned construct.

PLS Graph 3.0 computed the results for the item loadings and construct reliability, which are shown in Appendix 1. The item loadings, though lower than the recommended value of 0.7 are adequate for a study of this nature (see e.g. Hair et al., 1998). A plausible explanation for the low loadings might be related to the heterogonous nature of the participating firms and the types of ERP systems being used. On the other hand, the values for the composite reliability ranged from 0.769 to 0.924 (Appendix 1), which is higher than the recommended 0.7. Some researchers (e.g., Barclay et al, 1995) suggest that composite reliability is similar to Cronbach alpha and can be interpreted in the same manner. Thus, the composite reliabilities are reasonably high for our study suggesting that the measures used for the study are adequate (Nunnally, 1978; Hair et al., 1998).

The discriminant validity is assessed by checking the extent to which items measure a construct. This is assessed by checking the square root of the average variance extracted (AVE) for each construct. When the square root of AVE of a construct is substantially larger than the correlation coefficient between that construct and all other constructs, this provides a good measure of the variance shared between that construct and its indicators (Fornell and Larcker, 1981; Chin, 1998). Table 3 presents the inter-correlations among the constructs, AVE and the square root of AVE. Our measures indicate that the constructs are distinct and unidimensional. Overall, the convergent validity and discriminant validities of our data are adequate for an exploratory study such as this one (Hair et al., 1998; Chin, 1998; 2000).

Table 3. Inter-construct Correlations, AVE, and the Square Root of AVE (in bold font)

	AVE	1	2	3	4
1: Size	0.760	**0.872**			
2: Culture	0.401	0.417	**0.633**		
3: Structure	0.565	0.260	0.460	**0.752**	
4: ERP systems success	0.782	0.563	0.537	0.546	**0.884**

Notes:
1. Off-diagonal elements are correlations among constructs.
2. For discriminant validity, the correlation between the constructs should be lower than the squared root of AVE (leading diagonal).

The structural model gives information as to how well the theoretical model predicts the hypothesized paths or relationships. PLS Graph 3.0 provides the squared multiple correlations (R^2) for each endogenous construct in the model and the path coefficients. The R^2 indicates the percentage of a construct's variance in the model, while the path coefficients (ß) indicate the strengths of relationships between constructs (Chin, 1998; 2000). PLS does not generate a single goodness-of-fit metric for the entire model, unlike other structural modeling software, but the path coefficients and the R^2 are sufficient for analysis (Chin, 1998). The author also recommends that path coefficients (ß) should be at least 0.20 and ideally above 0.30 to be considered meaningful. We also tested the significance of paths using t-values obtained in the bootstrapping procedure in PLS Graph 3.0 by generating 200 sub-samples with 0 cases (Chin, 1998). The path coefficients and the R^2 are shown in Figure 3. For this study, the R^2 in the main effects model is 0.13, which suggests that the contingencies explained 13% of the variance in the ERP success construct.

Chin et al. (1996) provided a guideline for using PLS to test interactions. Essentially, each variable or indicator in the interaction is normalized or standardized by subtracting the mean from each indicator and dividing by its standard deviation. Next, multiplying the value of each of the constituting variables or indicators creates the interaction construct. Upon performing this operation, the R^2 in the interacting effects model yielded 0.19, suggesting that the contingencies explained 16% of the variance in the ERP success construct as would be expected with the added constructs. This is shown in Figure 4 where the dashed lines represent the

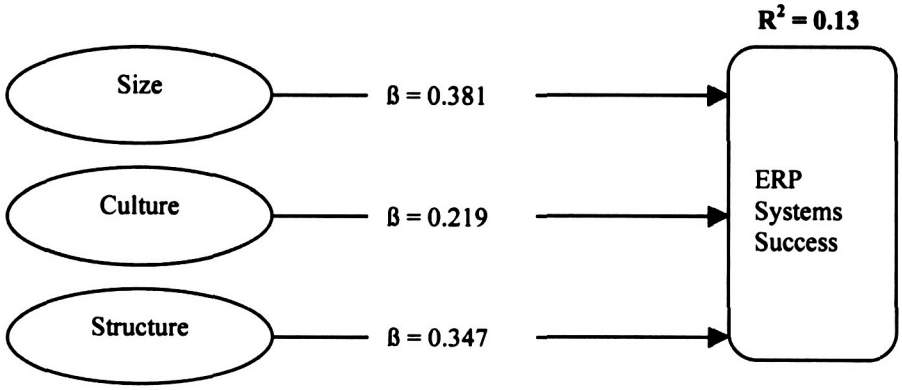

Figure 3. The PLS Graph 3.0 Results for the Main effects Model

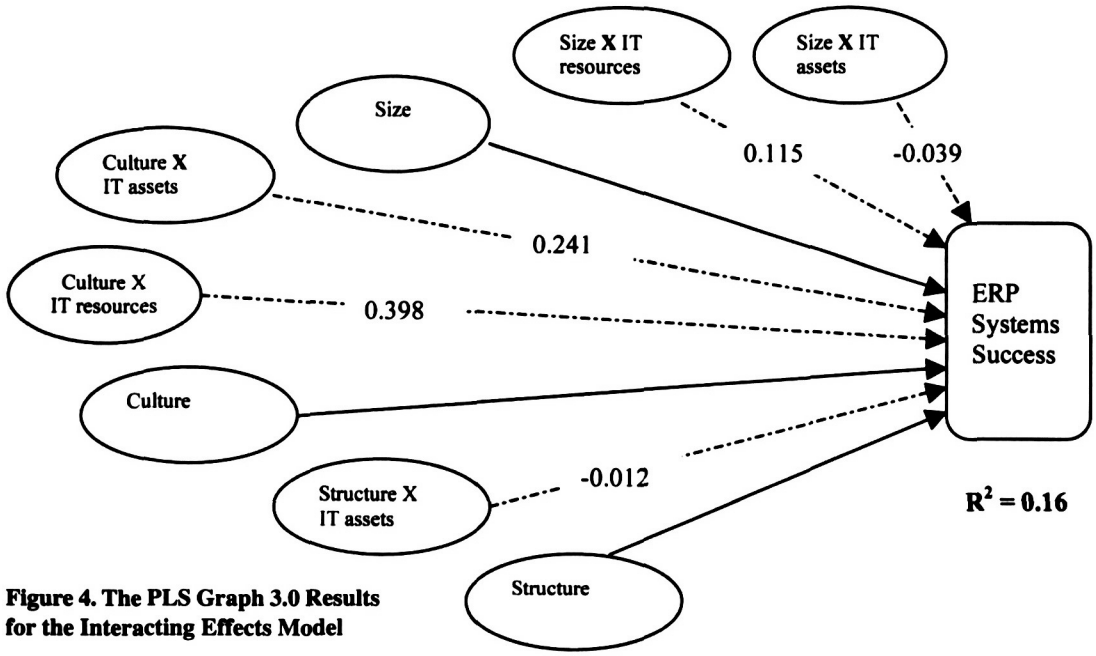

Figure 4. The PLS Graph 3.0 Results for the Interacting Effects Model

Table 4. Summary of Results

Hypothesis	Path coefficient (ß)	t-Value for path	Result
Size → ERP system success (H1a)	0.381	3.0572**	Supported
Size → EEERP system success moderated by IT assets (H1b)	-0.039	0.4270	Not Supported
Size → ERP system success moderated by IT resources (H1c)	0.115	1.8844*	Moderately Supported
Organizational culture → ERP system success (H2a)	0.219	1.1771*	Moderately Supported
Organizational culture → ERP system success moderated by the IT assets (H2b)	0.241	3.6521 **	Supported
Organizational culture → ERP system success moderated by the IT resources (H2c)	0.398	3.6900**	Supported
Organizational structure → ERP system success (H3a)	0.347	3.0998**	Supported
Organizational structure → ERP system success moderated by IT assets (H3b)	-0.012	0.1557	Not Supported

* significant at p< 0.01, ** significant at p< 0.001 (two-tailed)

interacting effects, and "X" denotes the interacting effects of measures.

DISCUSSIONS AND CONCLUSION

The objective of this study is to test the impacts of contingency factors, including size, culture and structure, on the one hand, and ERP systems success, on the other. We also designed our study to investigate the effects of the interactions between the aforementioned three contingency factors and IT assets and resources. We acknowledge that the contingency issues or factors that may influence how the success of complex IT systems such as ERP are assessed are wide ranging; however, the ones selected for this study are offered here as illustrative rather than exhaustive examples. Essentially, our research model draws from the Contingency Theory or approach, and we heeded the advice of Weill and Olson (1989) by not developing a model that is deterministic in outlook. In that regard, our research framework included the interacting effects of the organizational IT issues on the main contingency factors to engender understanding. Changes in R^2 can be examined to determine the effect size of interactions in a model (Cohen, 1988; Chin et al., 1996). Using guidelines provided by Cohen (1988), the result of the effect size (f^2) in our study indicated that the interacting effects of the organizational IT factors are substantive[2]; i.e., f^2 is 0.04.

A summary of our results is provided in Table 4. Our data provided moderate support for two of the eight hypotheses (i.e., H1c and H2a) and strong support for four hypotheses: H1a, H2b, H2c, and H3a. The results did not support two hypotheses: H1b and H3b.

It is easy to notice that the unsupported hypotheses were related to IT assets (IT staff expertise and the value of the IT department). The lack of variance on this issue may be logical and not a statistical fluke because it has been suggested that in-house IT professionals often do not possess relevant ERP expertise or skills and are often not considered as important actors during ERP acquisitions; thus, our data analysis of how these variables impact ERP success might be underscoring this reality. Indeed, the findings in our case studies on ERP success in both countries (Ifinedo, 2005; Ifinedo and Nahar, 2006) provide an indirect explanation suggesting that both large and small firms did not believe in having large IT departments for a variety of reasons, including their claims that the sorts of skills required for ERP systems implementation and maintenance were not readily available to their respective organizations (e.g., Markus and Tanis, 2000). Furthermore, studies also have shown that, in some instances, the reported levels of benefits resulting from ERP acquisitions across differing firm sizes are comparable (Mabert et al., 2003; Laukkanen et al., 2005; Ifinedo, 2005). That is, when evaluating benefits or success of ERP, a positive relationship to firm size (and, in this instance, its interacting effect with IT assets available in adopting firms) may not be found. Another plausible explanation for the unexpected findings may be due to the exploratory nature of the study, and to the operationalized measures employed, for example in relation to the organizational structure construct.

Hypothesis H1c, formulated to examine the impact of the interacting effects of IT resources and organization size, on the one hand, and ERP success, on the other, was also moderately supported. Consistent with this reasoning, our data confirms the views that larger organizations possessing more resources than smaller ones experience higher levels of success with their systems (e.g., Hunton et al., 2003; Laukkanen et al., 2005). Our data analysis also revealed that there is a moderate and positive relationship between organizational culture and ERP success, as hypothesized in H2a. Recall that our measures of culture relate mainly to the cooperative, supportive, and collaborative attributes of that concept. In that light, we can tentatively say that our data indicates that there is a moderate support for the relationship between the cooperative, supportive, and collaborative dispositions of employees and their perception of ERP success.

Our results show that organizational size is positively related to ERP success (H1a), and also suggest that larger firms may be experiencing higher levels of success from their ERP than smaller firms. Hypothesis H1b, discussed above, stating that "The relationship between firm size and ERP success will be moderated by IT assets, such that success will be higher in larger firms", is not supported. On the surface, this finding might appear to contradict the result obtained for hypothesis H1a. Nonetheless, our findings with respect to organization or firm size seem to indicate that skills of IT staff and their value to their organizations is not a moderator in the relationship between organizational size and ERP success whereas IT budget size and

the IT department size are. This revelation, in part, provides a concrete justification as to why a model that elaborates on the interacting effects or the moderating roles of differing factors may be enlightening.

Hypothesis H2b is strongly supported, suggesting that the interacting effect between organizational culture and IT assets is relevant for ERP success assessment. Ward and Peppard (1999) and Willcocks and Sykes (2000) note that IT systems success (including ERP) may be assessed higher in firms with cultural orientations that appreciate the importance or value of their IT departments. Hypothesis (H2c) relating to the interacting effect of IT assets and organizational culture, was similarly supported; in fact, the path coefficient ($\beta = 0.398$) in this relationship yielded that highest value to underscore the significance of this particular interaction in our structural model. Taken together, the data might be interpreted to mean that ERP success is evaluated higher where adopting firms have employees that possess supportive, cooperative, and collaborative attitudes, and where the in-house IT staff is skilled and highly valued, and above all, has sufficient resources (e.g. manpower and finance). Conversely, ERP success will be low where organizational members are not collaborative, cooperative, and supportive, and where their IT employees are not highly sophisticated, or the IT department is not highly rated and adequately financed. Finally, hypothesis H3a (A positive relationship exists between an organizational structure that is conducive to ERP adoption and ERP success), was supported. Given the measures operationalized for this construct, we can say that our data seems to indicate that ERP success may be higher where formalization and specialization are well-entrenched, and success with ERP may be higher where a command and control structure is in place (Davenport, 1998; 2000). Conversely, ERP success may be less in firms where such conditions are not yet in place.

Before discussing the implications of the study, we acknowledge that there are certain limitations to it. This study is exploratory, and our sample is not random. We cannot rule out personal bias in instances where a single informant presented an average view for his or her respective organization. Our choice of measures for some of the constructs could be improved. Furthermore, although our sample size of 62 is statistically sufficient for analysis, a larger sample size might produce better insights. This study presents the viewpoints of private sector organizations in a region of Europe. It is difficult to say whether our findings can be generalized to other regions of the world, such as Asia or America, and to public sector organizations for two reasons: 1) ERP implementation processes have been reported to be influenced by cross-national and cultural factors (e.g., Soh et al., 2000). Firms in the Baltic-Nordic region sharing similar characterization as the firms sampled in this study may reflect this finding. For example, Hansa, and Scala are examples of ERP systems originating from the region. 2) The operating environments in the public and private sectors differ considerably (Ifinedo, 2006b). Thus, this research may be replicable and applicable to firms in the private sector in small countries of the region, including Latvia, Lithuania, Iceland, and Norway. Furthermore, we used subjective and perceptual measures in this study; it is likely that objective measure of ERP success (i.e., profit and productivity measures) might yield a different result from those discussed in this paper. We did not control for the types of ERP used by the participating firms. Our sample comprised mixed ERP software, including top-brand names (e.g., SAP and Oracle) and mid-market products (e.g., Hansa, Scala, and Nova). It is possible that the heterogeneous nature of the ERP systems used for our study are limiting.

Implications

The findings of this study have implications for both practitioners and the researchers. We found that size, culture and structure are important antecedent contingency factors influencing ERP systems success. Against this backdrop, management of firms contemplating ERP adoption should pay attention to these issues. With regard to size, our analysis seems to support the view that larger firms adopting certain types of ERP software may experience higher levels of success perhaps because of the advantages inherent in the functionality of those systems or their size advantages (Hunton et al. 2003; Mabert et al., 2003; Sedera et al., 2003a). Broadly speaking, it may be advisable for firms, especially larger ones with ample resources, to invest in the sorts of ERP that are seen to be commonly adopted in large corporations. Mabert et al. (2003) and Ifinedo (2005) suggest that bigger firms tend to procure top brand ERP systems whereas smaller firm adopt mainly mid-market ERP products (Fisher et al., 2004). Even though this information might be useful for firms wishing to procure ERP for their businesses, it is nonetheless difficult to state authoritatively that certain ERP types will yield higher levels of success because anecdotal evidence exists suggesting that the mid-market ERP products may in fact be outperforming some of the top brands with regard to system functionality (see Computerwoche, 2003).

On the organizational cultural front, firms planning to adopt and those that have already adopted ERP must ensure that collaborative, cooperative, and, supportive attitudes are promoted in the organization. Our data analysis revealed that ERP success may be enhanced when such cultural attributes are rated highly (e.g., Swan et al., 1999; Swan et al., 1999; Krumbholz and Maiden, 2001; Kappos, 2000). Regarding organizational structure, as operationalized by formalization, centralization, and standardization, firms should be aware of where they stand before embarking on ERP adoption. It is known that the logic in ERP lends itself to certain structural dimension configurations (Davenport, 1998; 2000). Thus, it is likely that ERP will be less successful in firms where tasks are less specialized, organizational tasks are not properly delineated, and decentralization of authority pervades. This is a paramount finding that may benefit management of firms in the region (and elsewhere) with the intent of procuring ERP systems, as the findings in this study enlighten ERP adoption vis-à-vis organization design. Thus, we believe this foregoing information provides a rationale for adopting ERP in firms as opposed to instances where firms simply join the bandwagon of ERP adopters without any rationale.

Organizational IT issues, or factors such IS budget size, and size of the IT function, among others, are important factors to be considered in the context of ERP success assessment. Thus, management should endeavor to include wide-ranging issues both from the business and technological (IT-related) aspects of the organization when assessing the impact of contingency factors on the success of their ERP. Such an approach could enhance deeper insights. For example, we emphasized that by considering organizational culture alongside IT resources available to a firm, management may be able gain insights on how ERP success can be positively influenced. Incidentally, the Contingency Theory imply that higher success or effectiveness levels can be obtained where the influence of relevant issues is considered; thus, firms

where ERP is being adopted might enhance their ERP success by paying close attention to organizational IT issues and factors (Willcocks and Sykes, 2000).

There are implications for research. This paper is among the first to explore the effects of contingency factors on ERP success assessment. Accordingly, our study answers the calls made by other researchers to extend the scope of ERP studies. It is hoped that this endeavor will spur future fruitful inquiry in this area of research. We believe that our methodological approach exploring the interacting effects or the moderating roles of organizational IT factors and the three main contingency factors in a "non-deterministic model" is unique. Other studies using the contingency approach could consider employing our approach. More importantly, our analysis signifies the importance of organizational culture, structure, and size as relevant antecedents for ERP systems success. Specifically, our findings support the importance of conductive organizational culture for ERP acquisitions as suggested by Davenport (1998; 2000), Swan et al. (1999), Krumbholz et al. (2000), Jones and Price (2001), and Krumbholz and Maiden (2001). We posited and found support to viewpoints suggesting that firm size has a positive relationship with the success of IT systems in general (e.g., Ein-Dor and Segev, 1978; Raymond, 1985) and ERP systems in particular (Mabert et al., 2003; Sedera et al., 2003a; Sedera et al., 2004; Laukkanen et al., 2005).

Although researchers such as Morton and Hu (2004) have hypothesized relationships between structure and ERP success at the implementation phase, to our knowledge no prior empirical research has addressed the themes of ERP success at the post-implementation phase. In that regard, this endeavor is an initial attempt to empirically test and confirm these relationships between organizational structure and ERP systems success. Above all, our study underscored the importance of organizational IT issues and factors that prior researchers regarded as vitally important for success of IT systems in organizations (e.g., Ein-Dor and Segev, 1978; Raymond, 1985; Weill and Olson, 1989; Ward and Peppard, 1999; Willcocks and Sykes, 2000). This study highlighted the pertinence of IT assets and resources as moderators between the selected contingency factors and ERP success.

Future Study

The extent to which the finding of this study can be generalized depends on its validation and replication in other settings and regions. Particularly, future studies in the Baltic-Nordic region (and elsewhere) may replicate this effort with slight modifications. When possible, the findings of this study can derive external validity from such future efforts. A large data sample will be useful because the possibility of performing robust analyses will emerge. Given that organizational structure is found to be positively related to ERP success evaluations, we suggest that future studies could categorize firms using the organizational structure typologies proposed by Mintzberg (1980), wherever possible. Similarly, the low Cronbach alpha for organizational structure scale in this study might be an indication that more refinement is required; future efforts should consider modifying the scale. Future investigations could use case studies and objective data of ERP success to improve analysis. Additionally, more multiple indicators could be considered for organizational IT issues or factors. Alternatively, insightful interpretations might emerge if measures such as "IT department's value, "the sophistication of the IT staff", and so forth were treated as the main organizational IT factors and operationalized by multiple indicators. Additionally, research could examine the direct effects of organizational IT factors on ERP success assessment, and use the main three contingency factors as moderators. Future study may investigate the interaction between IT resources and organizational structure in relation to ERP success. Lastly, better insights and easily verifiable results could emerge if a single ERP type were used for a given study. This would ensure that confounding effects emanating from the use of heterogeneous ERP types would be controlled.

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ENDNOTES

1. Data collection sources:

- Helsinki Chamber of Commerce Business Directory 2004. Publication of the Helsinki Chamber of Commerce.
- Online database of Finnish companies: http://www.yritysopas.com/
- Top 500 Finnish Firms: www.top500.de/g0039407.htm
- SAP Finnish User Group: http://www.sapfinug.fi/
- Intentia Customers' List: http://www.intentia.com/WCW.nsf/CustomerPortalPage?OpenForm
- Scala Customers' List: http://www.scala.net/finland/asiakkaat/customers.asp
- Top Estonia Enterprises: Estonian Companies' Competitiveness Ranking 2004. Publication of the Estonian Chambers of Commerce.
- Estonian Chamber of Commerce and Industry Directory 2004. [Online]. http://mail.koda.ee/ektk/koda_eng.

2. The interacting effects:

The model with the interacting effects is compared to the model with the main effects. Cohen (1988) suggests effect size (f^2) for the interactions where 0.02, 0.15, and 0.35 indicate small, medium, and large effects, respectively. f^2 = [R^2 (interacting effect model) - R^2 (main effects)] / [1 - R^2 (main effects)]. The R^2 in the interacting effect main effects and main effects models are 0.1614 and 0.1301, respectively. Thus, $f^2 = 0.0360$

Appendix 1: Questionnaire's measures, Loadings, Cronbach alphas, Construct reliability

Main construct and interacting construct	Loading	Cronbach alpha	Construct reliability
Organization or Firm Size			
Workforce	0.8610	0.707	0.864
Annual turnover	0.8826		
Organizational Culture			
Management freely share information	0.6944		
Different departments are of equal importance	0.6197	0.766	0.769
Employees are happy with changes decide on ERP	0.5315		
Employees work in collaboration with others	0.6753		
Firm has clear norms and values	0.6330		
Organizational Structure			
Decision making is kept at the top	0.7754	0.402	0.796
Rules and procedures are known to all employees	0.7101		
Tasks are divided into separate jobs	0.7684		
ERP systems success			
Our ERP has accurate data.	0.6458		
Our ERP is easy to learn.	0.5749		
Our ERP has good features.	0.6329		
Our ERP allows data integration.	0.5232		
Our ERP is efficient.	0.4511		
Our ERP has timely information.	0.5890		
The information on our ERP is important.	0.5990		
The information on our ERP is relevant.	0.6890		
The information on our ERP is usable.	0.7025		
The information on our ERP is available.	0.6633		
Our ERP vendor/consultant provides adequate technical support.	0.5761		
Our ERP vendor/consultant is credible and trustworthy.	0.6334		
Our ERP vendor/consultant has good relationships with my organization.	0.5942		
Our ERP vendor/consultant is experienced and provides quality training and services.	0.6368	0.932	0.924
Our ERP vendor/consultant communicates well with my organization.	0.5628		
Our ERP enhances organizational learning and recall for individual worker.	0.5192		
Our ERP improves individual productivity.	0.5089		
Our ERP is beneficial for individual's tasks.	0.6448		
Our ERP enhances higher-quality of decision making.	0.5378		
Our ERP saves time for individual tasks and duties.	0.5820		
Our ERP helps to improve workers' participation in the organization.	0.5601		
Our ERP improves organizational-wide communication.	0.6659		
Our ERP creates a sense of responsibility.	0.7601		
Our ERP improves the efficiency of sub-units in the organization.	0.5109		
Our ERP enhances solution effectiveness.	0.6882		
Our ERP provides us with competitive advantage.	0.6216		
Our ERP increases customer service/ satisfaction.	0.5916		
Our ERP facilitates business process change.	0.6983		
Our ERP supports decision making.	0.7535		
Our ERP allows for better use of organizational data resource.	0.7334		

The ERP systems success measures are assessed on a Likert scale (1=strongly disagree, 2=disagree, 3=somewhat disagree, 4=neutral, 5=somewhat agree, 6= agree, and 7=strongly agree).

Appendix 2: Factor Analysis of the Main Effects and Dependent Variable

Measure	Factor 1	Factor 2	Factor 3	Factor 4
Rules and procedures are known to all employees.	.003	.606	.022	.397
Tasks are divided into separate jobs.	-.043	.039	.127	.601
Decision making is kept at the top.	-.073	-.201	-.111	-.032
Different departments are of equal importance.	.127	-.122	.660	.239
Employees are happy with changes decide on ERP issues.	.221	-.234	.485	.394
Employees work in collaboration with others.	.290	.108	.470	.322
Firm has clear norms and values.	.155	.096	.040	.660
Management freely shares information.	.262	-.024	.638	.163
Size (workforce)	.046	.404	-.432	.351
Size (annual turnover)	.316	.081	-.502	.280
Our ERP has accurate data.	.088	.760	-.029	.113
Our ERP is easy to learn.	-.079	.557	.439	-.272
Our ERP has good features.	.591	.024	.247	-.287
Our ERP allows data integration.	.406	.460	.160	-.506
Our ERP is efficient.	.354	.570	.215	-.314
Our ERP has timely information.	.198	.818	-.068	.065
The information on our ERP is important.	.492	.061	.132	-.064
The information on our ERP is relevant.	.609	.116	.341	-.304
The information on our ERP is usable.	.493	.299	.396	-.382
The information on our ERP is available.	.634	.040	.372	-.135
Our ERP vendor/consultant provides adequate technical support.	.405	.473	.354	.034
Our ERP vendor/consultant is credible and trustworthy.	.269	.277	.747	-.112
Our ERP vendor/consultant has good relationships with my organization.	.292	.130	.787	-.130
Our ERP vendor/consultant is experienced and provides quality training and services.	.203	.286	.763	-.080
Our ERP vendor/consultant communicates well with my organization.	-.053	.283	.680	.240
Our ERP enhances organizational learning and recall for individual worker.	.162	.443	.505	.249
Our ERP improves individual productivity.	.324	.312	.377	.470
Our ERP is beneficial for individual's tasks.	.515	.126	.021	.067
Our ERP enhances higher-quality of decision making.	.503	.541	.240	-.046
Our ERP saves time for individual tasks and duties.	.244	.732	.144	-.089
Our ERP helps to improve workers' participation in the organization.	.096	.744	.071	.148
Our ERP improves organizational-wide communication.	.423	.700	-.043	-.128
Our ERP creates a sense of responsibility.	.382	.246	.196	.228
Our ERP improves the efficiency of sub-units in the organization.	.616	.103	-.007	.362
Our ERP enhances solution effectiveness.	.426	.423	.046	.337
Our ERP provides us with competitive advantage.	.618	.225	-.092	-.006
Our ERP increases customer service/ satisfaction.	.571	.154	.196	.120
Our ERP facilitates business process change.	.548	.188	.079	.333
Our ERP supports decision making.	.754	.142	.052	.236
Our ERP allows for better use of organizational data resource.	.700	.171	.161	.104
Eigenvalue	11.19	3.91	3.16	2.71
% Cumulative variance	28.0	37.7	45.6	52.4

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 7 iterations.