A Case Study on the Impact of Customization, Fitness, and Operational Characteristics on Enterprise-Wide System Success, User Satisfaction, and System Use

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ABSTRACT

Enterprise resource planning (ERP) system success is of paramount importance for almost all organizations, as it is a prerequisite for improved and continuous benefit-realization. This study investigates the impact of ERP business dynamics (i.e., system customization required), system fitness (i.e., process fit, data fit, and user interface fit) and functional area operational characteristics on ERP system success, user satisfaction and system use. The author draws on relevant theoretical background information to construct the research model. Surveys are administered to 91 ERP system users within a multinational food company; in-depth interviews are also conducted with some system users. Empirical results indicate that the amount of ERP system customizations and/or modifications does not have any substantial impact on ERP system use or user satisfaction. In terms of ERP system fitness, these systems are found to be more suitable for complex, functional-area operational environments. The results show that only user interface fit positively affects ERP system use, while only process fit positively influences ERP system user satisfaction. In addition, different degrees of information quality, system quality and service quality have diverse effects on some of the relationships investigated. Finally, the perceived net benefit from an ERP system depends on how the ERP system is used, rather than the management level of the users.

Keywords: *Enterprise Resource Planning (ERP), ERP Customization, ERP Fit, Explanatory Case Study, IS Success, Multinational Company, User Satisfaction*

INTRODUCTION AND PURPOSE

Enterprise resource planning (ERP) systems are large, integrated, and cross-functional software packages that cater to the majority of fundamental functional-areas (if not all departments) in an organization. Most large firms across many industries view ERP systems as a required competitive criterion, as well as a must-have in terms of IT infrastructure (Ragowsky & Gefen, 2008; Reilly, 2005). The ERP applications market in

DOI: 10.4018/jgim.2013010102

2008 totaled US$33 billion in licensing, maintenance and subscription revenue; IDC research estimates that this will reach US$40.4 billion in 2013, based on a 4.2% compound annual growth rate (CAGR) (Pang, 2009).

Existing research studies indicate mixed success regarding ERP systems. Organizational change management, project management, and user behavior management have experienced positive results, but there have also been ERP customization failures (Ganesh & Mehta, 2010; Garg, 2010; Gattiker & Goodhue, 2004; Kholeif, Abdel-Kader, & Sherer, 2007). Although many enterprises believe that ERP implementation can increase their market competitiveness and provide other advantages (Jacobson, Shepherd, D'Aquila, & Carter, 2007; Olson, 2004; Shang & Seddon, 2003), differences in organizational culture, organizational structure and the flow path of enterprise operations have resulted in mixed success in terms of the final outcomes and the quality or degree of success, as well as increased risk and ERP misfit issues for many enterprises (Wang, Klein, & Jiang, 2006).

While some companies deal with these types of ERP misfits by reengineering their business processes, most prefer to customize and modify the packaged software, especially for business mission-critical processes. However, altering standard ERP system codes complicates future upgrades and maintenance work (Light, 2001; Ng & Gable, 2010). As such, companies require a deeper understanding of how ERP fit and customization influence user satisfaction with the system, its use, and the system net benefits. From a technical perspective, the fit between organizational business processes and ERP packaged software business processes helps to determine the quality of the implemented ERP system (Wang et al., 2006). That said, Gefen and Ragowsky (2005, p. 20) suggest "benefits gained by ERP systems will be better predicted by being measured separately at the level of activity areas within the organization, rather than at the broad level of the entire ERP system." Likewise, it is more appropriate to evaluate ERP fit/misfit issues at the level of activity areas or business units within the organization.

Certainly, ERP success in the post-implementation (PI) phase is required in order to realize the business benefits from the system, as well as for continuous benefit-realization of both individual benefits (e.g., individual productivity and better decision-making quality) and organizational benefits (e.g., better revenue generation and business process efficiency). Prior research on ERP fit focuses on diversified aspects such as ERP misfit typology (Soh, Sia, & Tay-Yap, 2000), user characteristics (Holsapple, Wang, & Wu, 2005), ERP system country of origin and organizational issues (Wang et al., 2006), organizational fit (Hong & Kim, 2002), organizational unit's coordination improvement and task efficiency (Chou & Chang, 2008), strategic alignment (Davies, 2005) and impact on future maintenance (Light, 2001). In general, these studies emphasize IT-business alignment issues. However, the current study investigates several quality (i.e., information, system and service) and operational issues that are less strategic in nature as compared to the focus of existing studies.

This study extends the work of Holsapple et al. (2005) and Wang et al. (2006) by investigating differences in ERP system use and user satisfaction with ERP systems based on the amount of customization, process fit, user interface fit and data fit. This study also responds to a call for further investigation (Chou & Chang, 2008) of the dynamic interrelationships between context (such as organizational, business process, user characteristics and business unit characteristics) and the level of ERP fit, as well as the different types of ERP fit. Moreover, we explore how information quality, system quality and service quality influence the relationships between the independent and dependent variables investigated in this study. Table 1 lists the pertinent existing research regarding the link between ERP fitness and ERP success.

Table 1. Prior studies on the relationship between ERP fitness and ERP success

Prior Research	Variables Studied	Dependent Variable(s)
(Hong & Kim, 2002)	Organizational fits – data fit, process fit, user interface fit	ERP implementation cost, time, system performance
(Holsapple et al., 2005)	User characteristics – age, education level, computer experience, management level Fitness – compatibility, task relevance	User satisfaction
(Gattiker & Goodhue, 2005)	Subunit interdependency and differentiation among organizational subunits	Intermediate and local-level ERP benefits or performance
(Wang et al., 2006)	ERP system country of origin, perceived initial ERP misfit, top management support, user support, consultant quality	Perceived ERP system quality
(Chou & Chang, 2008)	Customization, organization unit's coordination improvement and task efficiency, strategic and operational organizational mechanism	ERP overall benefits or performance

Three research issues guide this study: (1) the types of ERP system fit that influence ERP system use, user satisfaction and system net benefits (or performance-impacts); (2) the types of operational characteristics that influence ERP system fit, the degree of customization, and system use; and (3) how different levels of ERP system quality, information quality, and/or service quality affect the relationships among the various types of ERP fit, operational characteristics and the degree of customization as compared to ERP system use, user satisfaction and system net benefits (i.e., success). To address these research issues, surveys and in-depth interviews are conducted at a multinational company that has data bearing on the cause-effect relationship among the variables investigated in this study.

The remainder of this paper is organized as follows. The first section provides a literature review on the theoretical background of the IS success model, business unit operational characteristics, ERP customizations and various types of ERP misfit. The next section describes the research methods adopted in this study, while the next section presents the research findings. Finally, the author details the theoretical and practical contributions and implications of this study.

LITERATURE REVIEW

The "Information System (IS) Success Model" (DeLone & McLean, 1992, 2003) includes a wide range of IS success variables, covering both general IS aspects and performance impacts. Although the majority of the success variables focus on individual perspectives, it also covers some group and organizational perspectives. The IS success model is also used to measure IS system characteristics such as system quality and information quality, as well as other facets including system use, user satisfaction, and net benefits. Further, the net benefit dimension consists of both the individual impact and organizational impact, although "The choice of where the impacts should be measured will depend on the system or systems being evaluated and their purposes" (DeLone & McLean, 2003, p. 19).

The present study defines ERP system success by extending the IS success definition provided by DeLone and McLean (2003) as follows: a packaged software system, with a robust system quality and information quality that meets the overall requirements of a client-organization, which leads to an increase in information system usage, subsequent user satisfaction, and net benefit (i.e., improvements in individual, business unit and/or organization performance) to an organization. For these to occur, reasonable fits are expected between the ERP functionalities and organizational business tasks, and between the ERP functionalities and business units' operational characteristics. Moreover, the use of the DeLone and McLean (2003) IS success model to study ERP success is not new. Sedera and Gable (2004) use a confirmatory factor analysis that includes structural equation modeling techniques to identify four distinct, important dimensions of enterprise systems success (ESS): individual impact, organizational impact, system quality and information quality.

According to Markus and Tanis (1999), success can mean different things depending on who defines it. For instance, system users define system success as satisfaction with the system (Wu & Wang, 2007), whereas managers are likely to define system success in terms of performance gains (Rai, Patnayakuni, & Seth, 2006). Markus and Robey (1988) note that no single measure is better than another; therefore, the choice of the success variable usually depends on various aspects including the objectives of the study, organizational context, type of information system, research method and level of analysis.

Operational Characteristics

An ERP is an organizational-wide IS that is meant to be utilized by multiple departments or business units and organizations for various purposes; as such, its impact on different business units and in different organizational contexts may not be the same (Gattiker & Goodhue, 2005; Ragowsky & Gefen, 2008), since these business units or functional-areas have different operational characteristics. For example, various functional areas deal with diverse volumes of data input and output, access different databases, and employ different business processes when interacting with other business units. Gattiker and Goodhue's (2005, p. 580) analysis of data from 111 U.S. manufacturing plants supports the idea that "interdependence [interactions among other subunits] is associated with increased plant-level benefits from ERP while differentiation is associated with the opposite."

The operational characteristics of more complex business units typically require frequent business process interactions with the various other business units, as well as the processing of large volumes of data inputs and outputs due to the substantial number of suppliers, customers, sales orders and purchase orders per month (Ragowsky, Stern, & Adams, 2000). This is especially true for a multinational company that requires integration of cross-border investment, production and trade; maintenance of a more diversified product portfolio; management of various marketing and sales activities across multiple markets; and constant monitoring of the dynamic and challenging global financial environment (Kristensen & Zeitlin, 2007).

Ragowsky and Gefen (2008, p. 38) state that "the more complex the operational environment [e.g., a multinational company environment], the more value the ERP system can have by allowing the company to adjust and respond better to its operational environment" (p. 38). This implies that ERP systems are more suitable for more complex operational environments. As a multinational company consists of numerous business units with various complex operational characteristics, we expect to find differences in terms of each business unit's use of the ERP system. Also, as ERP systems are more suitable for more complex operational environments, it is logical to expect that complex operational environments are associated with greater ERP data fit, process fit and user interface fit within the multinational organization. As such, we hypothesize that:

H1a: A business unit with more complex operational characteristics is associated with greater ERP system use.

H1b: A business unit with more complex operational characteristics is associated with greater ERP data fit.

H1c: A business unit with more complex operational characteristics is associated with greater ERP process fit.

H1d: A business unit with more complex operational characteristics is associated with greater ERP user interface fit.

Further, ERP systems are usually packaged software systems composed of business processes that are recognized as common best practices (of an industry). In order to bridge potential gaps between an ERP system business processes and the unique requirements of a particular business unit, the ERP system can be customized. Based on data collected from five case studies, Haines (2009) shows that there is substantial evidence of a link between customization and a business unit's uniqueness or differentiation. Further, logic dictates that the operational characteristics associated with a more complex business unit are also more likely to call for unique and idiosyncratic business requirements, which leads to differentiation among the various business units. As a result, we expect that

H1e: A business unit with more complex operational characteristics is associated with a higher degree of ERP customization.

Degree of Customization

Different companies are associated with different business dynamics, organizational structures, business processes, and standard operation procedures (Chang, Hung, Yen, & Lee, 2010). Multinational companies have highly complex operational environments due to the dynamics inherent in the nature of their operations. Christiannse and Damsgaard (2001) show that in such complex operational environments, successful deployment of IT/IS is a significant challenge; potential reasons for this include international competition, international investment, currency volatility, multiplicity of different regional labor markets, and the unpredictable cost of supplies and value of sales (Cullen & Parboteeah, 2010). Compounding the pressing need to differentiate from others in order to maintain competitiveness is the potential emergence of some idiosyncratic processes that deviate from standard processes. In such cases, ERP packaged software customizations are usually inevitable.

As mentioned above, ERP customization can enhance the fit between ERP packaged software and the requirements of an ERP client-organization. Through ERP customization, the business processes of the ERP system are changed to meet the ERP client-organization business needs and organizational designs of a multinational company (Markus, Sia, & Soh, 2012). Findings from Gattiker and Goodhue (2005, p. 577) indicate that "ERP customization as a main effect can improve local [or business unit] efficiency." Further, Chou and Chang (2008) note that ERP customization results in improvements in both organizational unit coordination and task efficiency, while Holsapple et al. (2005) find that the fitness factors (i.e., compatibility and task relevance) have significant positive influences on ERP system user satisfaction. In light of this evidence supporting the notion that customization has the capability to address misfits and misalignment between organizational needs and ERP system functionalities, we argue that

H2a: A higher degree of ERP customization is associated with greater ERP system use.

H2b: A higher degree of ERP customization is associated with greater ERP system user satisfaction.

ERP Fit and Misfit

Often, ERP package purchasers find that at least 20% of their requirements are not included as part of a standard package (Scott & Kaindl, 2000). At the University of Nebraska, the average fit between the implemented SAP package was 60%, and as low as 30% in some areas (Sieber, Siau, Nah, & Sieber, 2000). While ERP packaged software is well-known for various misfit problems (Soh et al., 2000; Wang et al., 2006), these can usually be solved using various customization and modification techniques (Brehm, Heinzl, & Markus, 2001). That said, IS performance and use rate are both affected by the fit between the tasks and the IS structure, capabilities and/or functions (Dennis, Wixom, & Vandenberg, 2001; Todd & Benbasat, 2000). According to Dishaw and Strong (1999), a positive performance-impact only occurs when the technology employed fits the business operation tasks and also satisfies worker/employee needs in terms of accomplishing tasks more effectively and efficiently. This also holds true for ERP systems, as they are used by different organizational groups for various functional-area operational purposes.

Hong and Kim (2002) measure ERP organizational fit in terms of data, process and user interface. These authors include user interface fit as an additional dimension to those originally proposed by Soh et al. (2000) pertaining to ERP organizational fit and use data fit to refer to both data and output fit. To maintain relevancy, the current study adopts the three types of fit suggested by Hong and Kim (2002). According to Soh et al. (2000), data fit is defined as the compatibility between ERP client-organization requirements and the ERP packaged software in terms of data format and data relationships; output fit focuses on the presentation format and the information content of the output; and process fit describes the compatibility in terms of the processing (e.g., access, control and business operation) procedures. On the other hand, user interface fit concentrates on the compatibility between the ERP client-organization user requirements and the ERP package in terms of user interface design, structures and usability (Hong & Kim, 2002). It is logical to assume that high compatibility in terms of data fit between the ERP client-organization requirements and the ERP package will enhance ERP system use and user satisfaction; this also applies to process fit and user interface fit. Following this line of argument, we posit that

H3a: A higher degree of data fit is associated with greater ERP system use.

H3b: A higher degree of data fit is associated with greater ERP system user satisfaction.

H4a: A higher degree of process fit is associated with greater ERP system use.

H4b: A higher degree of process fit is associated with greater ERP system user satisfaction.

H5a: A higher degree of user interface fit is associated with greater ERP system use.

H5b: A higher degree of user interface fit is associated with greater ERP system user satisfaction.

Control Variables

According to DeLone and McLean (2003), superior system quality, information quality and service quality will lead to an increase in IS usage and in turn increase user satisfaction. While DeLone and McLean (2003) emphasize that system quality and information quality are the most crucial dimensions in evaluating the 'success of a single system,' Pitt, Watson, and Kavan (1995) suggest that service quality is the most crucial variable in evaluating the 'overall success of an IS department.'

An ERP system that provides better system quality and information quality is more likely to meet an ERP client-organization's overall requirements for data, user interface and business operation needs, and allows the IT department to provide better service to system users. In turn, ERP users will increase their usage intention and system usage, as well as their satisfaction with the ERP system.

Boudreau (2003) finds that users' understanding of ERP systems, which is typically obtained through learning and training, largely contributes to the appropriate use of these systems. In addition, ERP system users' satisfaction is positively related to the amount of training they receive (Bradford & Florin, 2003). In other words, training leads to an improvement in ERP system user's satisfaction with an ERP system and ERP system usage; eventually, this is expected to create benefits for both the individual and organization (Guimaraes, Yoon, & O'Neal, 1995). An illustration of the impacts of these control variables on the hypotheses proposed above is shown in Figure 1.

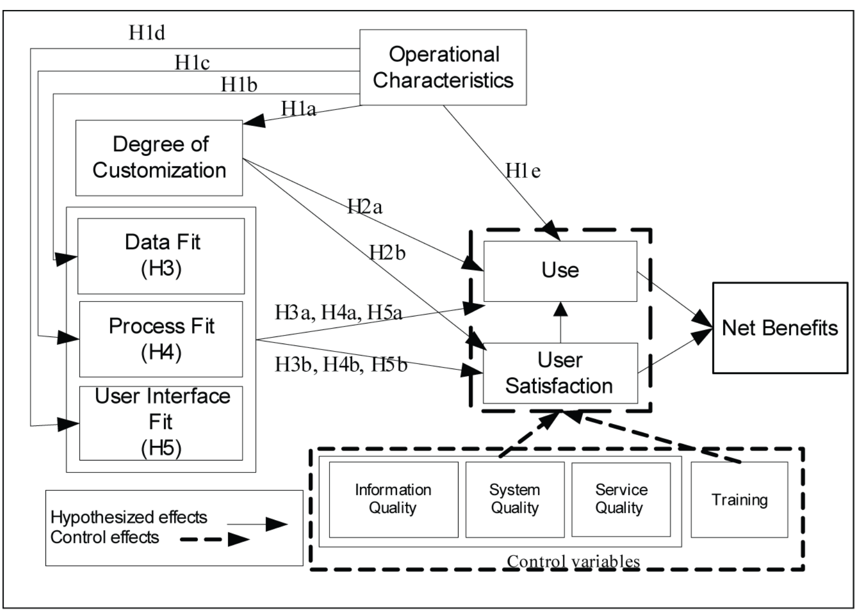
RESEARCH METHOD

This study involves the collection of data through surveys in a single, causal and explanatory case study. The survey method is appropriate, as the purpose of this study is to investigate the causal relationships among the independent and dependent variables identified from existing theories in the literature, while the explanatory case study design can be used to test and build theories (Yin, 2003). The case study method is also useful to contextually and situationally explain, understand and discover research findings and insights in a natural situation. The use of a single case in an explanatory case study can be justified when the case is a critical one, which incorporates previously inaccessible data that helps to uncover the *how*- and *why*-research questions that were not answered in previous studies (Yin, 2003). A multinational company is selected because (1) the case firm represents a critical case that has data bearing on the cause-effect relationship to support/illustrate the relationships among the variables shown in the conceptual model (i.e., Figure 1); and (2) the case firm has used an ERP system internally for more than two years. The latter is especially significant as this study measures the performance (net benefits) associated with the ERP system (Nicolaou, 2004).

Data Collection Method

Data collection in this study was primarily done using surveys, while qualitative methods including interviews and documentation were selectively used to support and explain the survey results. Two surveys were distributed: one to all SAP system users including key users and managers, and the other only to key users and managers from all departments or functional-areas in the multinational firm. System users were defined as employees who used the SAP system and were familiar with its qualities and usefulness. Key users were defined as being even more familiar with the SAP system in terms of the degree of process fit, user interface fit and data fit between the standard SAP system

Figure 1. Conceptual model of ERP success (adapted from DeLone & McLean, 2003)



and their firm's business processes—they had participated in the initial ERP implementation, understood their functional-area business processes well, and had coached other users on the use of the system. Finally, managers were defined as those in middle-level management and above; they were more informed regarding the impact and business benefits derived from the SAP system, their departmental operational characteristics and the degree of departmental use of the SAP system.

These two surveys were carried out simultaneously during January 2009 in order to shorten the data collection time. The references used to develop the survey items are shown in Table 2. To meet the definition of system usage in this study, the participants were strictly controlled: questionnaires were sent out directly only to those employees who had SAP system accounts and were required to use the system to perform their job. These respondents were requested to evaluate the questionnaire items based on seven-point Likert scales ranging from 1 (strongly disagree) to 7 (strongly agree).

For the first questionnaire targeting all SAP users, 109 surveys were sent out. The questionnaire items covered issues related to information quality, system quality, service quality, system use, individual net benefits and user satisfaction, in addition to several demographic-related items. Within three weeks, 92 survey responses were personally collected by an informant working in the company for a total response rate of 84.4%. One response was deemed invalid due to incompleteness, so the actual valid response rate was 83.49%. The expected minimum sample size in this study is equal to 10 times the largest number of structural paths directed at a particular latent construct in the structural model (Hair, Ringle, & Sarstedt, 2011). Excluding the four control variables, the 'system use' latent variable had the largest number of structural paths—six; as such, the 91 data points exceeded the minimum sample size requirements (Figure 1).

The second questionnaire, designed to collect information on departmental operational characteristics, departmental system use and

Table 2. References used to develop the survey instrument

Constructs	Resource Reference	How the Data was Collected
System Quality	(DeLone & McLean, 1992)	1st survey – Survey all system users (including the key users and managers) => collected at the individual-level
Information Quality	(DeLone & McLean, 1992)	
Service Quality	(Pitt et al., 1995)	
System Use	(Venkatesh, Brown, Maruping, & Bala, 2008)	
User Satisfaction	(Rai et al., 2006)	
Net Benefit	(Rai et al., 2006; Seddon, 1997)	
Degree of Customization	Developed as part of this study	2nd survey – Survey only the key users and managers => collected at the department-level
Data Fit	(Hong & Kim, 2002)	
Process Fit	(Hong & Kim, 2002)	
User Interface Fit	(Hong & Kim, 2002)	
Training	(Wheeler & Valacich, 1996)	
Operational Characteristics	Developed as part of this study	
System Use (by the department)	Developed as part of this study	
Net Benefit	(Rai et al., 2006; Seddon, 1997)	

overall performance, was sent specifically to the key users and managers from each department by an informant working in the multinational firm. It is important to note that for this survey, participants from these two groups only answered questions that were relevant to them or their jobs.

In total, 18 key users and managers across 11 different departments were invited to answer the second survey after completing the first survey. In this second survey, the survey items pertained to the training, process fit, user interface fit, data fit, degree of customization, operational characteristics and business unit's overall ERP system usage and net benefits. Some questions in this survey required previous knowledge of various ERP system fit issues and customizations performed during the initial ERP system implementation stage. As such, participants occasionally had to recall prior events and/or made references to previous archival record and supporting documentation, where the accuracy of their responses depended on their memory. All 18 subjects completed and returned the questionnaire—no invalid responses were received.

Following each survey, the quantitative data was entered into an Excel file and analyzed using both SPSS statistical packaged software and SmartPLS (Ringle, Wende, & Will, 2005). Partial least squares (PLS) structural equation modeling was used to analyze the data as (1) the research model was complex and had a sample size that would be too small for covariance-based SEM techniques such as Lisrel and Amos (Chin, 2010; Goodhue, Lewis, & Thompson, 2006); (2) this study aimed to test the proposed research model derived based on existing theoretical knowledge (Marcoulides & Saunders, 2006); and (3) this research model emphasized a predictive focus and soft distributional assumptions (Chin, 2010).

Operationalization of the Constructs

We used the variables "ease of use" and "ease of learning" to measure the system quality construct. According to Davis (1989), these are the fundamental determinants of computer usage. The most important measures pertaining to 'information quality' are precision, relevance, completeness, and information accuracy (Bailey & Pearson, 1983). Service quality measures employed include the IT department's dependability, willingness to help, and job-related knowledge (DeLone & McLean, 2003). To measure user satisfaction, a single-item measure can be used when an overall indication of user satisfaction is desired, and no particular areas of content or discontent are of concern (Baroudi & Orlikowski, 1988; Rai et al., 2006). According to Bailey and Pearson (1983), "satisfaction in a given situation is the sum of one's feelings and attitudes towards a variety of factors affecting that situation" (p. 531). Further, we employed a single-item measure for user satisfaction to ensure a reasonable survey length.

Numerous researchers have suggested "IS use" as a method to measure IS success (Hamilton & Chervany, 1981). Robey and Zeller (1978) emphasize that "IS success" refers to the adoption and extensive use of an IS. Consistent with Trice and Treacy (1986), Venkatesh et al. (2008) propose the duration, frequency and intensity of computer access measures to measure "IS use" or system use.

Evaluating the success or failure of the ERP/IS "impact" (the net benefit on individual users) is not easy; however, it is closely related to performance. Rai et al. (2006) adopt the perceived usefulness variable to measure the impact, while Chow (2011) notes that perceived usefulness has an inductive effect on IS usage. Seddon (1997) defines perceived usefulness as "the degree to which the stakeholder believes that using a particular system has enhanced his or her job performance." As such, in the current study the net benefit of an ERP system is measured as the degree to which the system enhances one's job performance, effectiveness on the job, usefulness on the job and capability to accomplish the job more quickly. On the other hand, for the training construct, it is measured as the degree to which the group is trained on how to use the ERP system in order to ensure smooth daily business operations.

ERP system fit is measured based on three dimensions: data fit, process fit and user interface fit (Hong & Kim, 2002). We adapted survey questions on all three dimensions of ERP system fit from Hong and Kim (2002).

The degree of system customization was measured based on the following survey questions: "Our ERP system was altered to improve its fit with this business unit," "A standard version of the ERP software was implemented without any changes being made to fit the particular requirements of this business unit" (reverse question), and "When the ERP system was being implemented in this business unit, the package was changed to better meet the needs of this business unit."

Operational characteristics were characterized based on the amount of input data required, data processed, reports produced, databases employed and business processes that interacted with other business processes from different departments. These items were also rated on a seven-point Likert scale anchored by 1 (extremely simple/straightforward) and 7 (extremely complex); the description of the actual scales used are provided in Appendix B. Table 3 provides definitions for all the variables involved in this study.

The Case Company

To maintain the anonymity of the participating company, we refer to it as MN Company. It is a multinational company that belongs to the MN Group—one of the world's largest suppliers of food processing and packaging, including packaging for ice-cream, cheese, dry food, fruit and vegetables.

In 2008, MN Group produced more than 137.3 billion product packages and provided

Table 3. Variable definition

Variable	Definition
System Quality (SQ)	The degree of ease of use and ease of learning associated with the ERP system
Information Quality (IQ)	The degree of the data/information precision, relevance, completeness, and accuracy
Service Quality (SE)	The degree of the IT department's dependability, willingness to help, and job-related knowledge
Use (US)	A measure of the duration, frequency and intensity of ERP system access
User Satisfaction (SA)	The degree of user satisfaction with the ERP system
Net Benefit (PU)	The degree of perceived usefulness associated with the ERP system in enhancing one's job performance, effectiveness on the job, capability to finish the job faster and being useful on the job
Training (TR)	The degree to which ERP system users are trained on how to use the system in order to ensure smooth daily business operations
Data Fit (DF)	The degree of fit between the form and format of (the input and output) data items of the ERP system and the form and format of (the input and output) data items used by a business unit
Process Fit (PF)	The degree of fit between the processes flow built into the ERP system and the flow of a business unit's business processes
User Interface Fit (UF)	The degree of fit between the user interface of the ERP system and the user interface needs of a business unit
Degree of Customization (CU)	The degree to which an ERP system was altered to meet the needs of a business unit
Operational Characteristics (OC)	The amount and/or complexity of input data, data to process, reports produced, databases and business processes interacting with other business processes from different departments

69.5 billion liters of liquid packaging to consumers around the world; this led to global net sales of approximately 11 billion U.S. dollars. In that same year, MN Group consisted of 43 marketing companies, 43 packaging material factories, and 11 packaging machine assembly factories; its products were sold in more than 150 markets worldwide. Today, MN Group operates in more than 100 countries with over 20,000 employees worldwide.

In 1987, MN Group set up a new manufacturing plant in Taiwan and began its business development and production. This plant, MN Company, currently has 220 employees and authorized capital of approximately 12 million U.S. dollars.

MN Group's legacy systems were originally developed separately and had already been in use for more than 20 years at MN Company. The trade procedure between the branches of MN Group and its customers was particularly frequent and quite complex; as such, they required a powerful IS. Though each specific system could accommodate the functional requirements associated with each department, it was hard to make changes or enhance the aging legacy systems to meet MN Group's overall competitive needs.

Further, by 2004 MN Group was facing fierce competition from substitute products such as plastic packages developed specifically for chilled beverages, which was eroding MN Company's market share. In turn, MN Company realized that the changing business environment called for investment in new global business processes and a fully-integrated IS. In 2005 MN Company decided to implement an ERP system to increase competitiveness, integrate internal core business processes with those of customers and suppliers, and speed up their customer service.

Fortunately, MN group already experienced a total of 16 successful ERP system implementations in Europe and North America. In order to ensure the necessary support from global headquarters and align MN Company's worldwide business development with that of their global headquarters, MN Company decided to adopt the same ERP system, i.e., SAP R/3 4.7. MN Company implemented 10 ERP modules at one time, including SD (Sales & Distribution), MM (Material Management), PP (Production Planning), SM (Service Management), FI (Financial Accounting), CO (Controlling), PS (Project System), WF (Workflow), HR (Human Resources), and BW (Business Warehouse). In total, 11 departments would make full-scale use of these modules. The ERP system went live in May, 2006. Therefore, during the data collection period, the system users already had three years and one month of experience with the system.

FINDINGS AND DISCUSSION

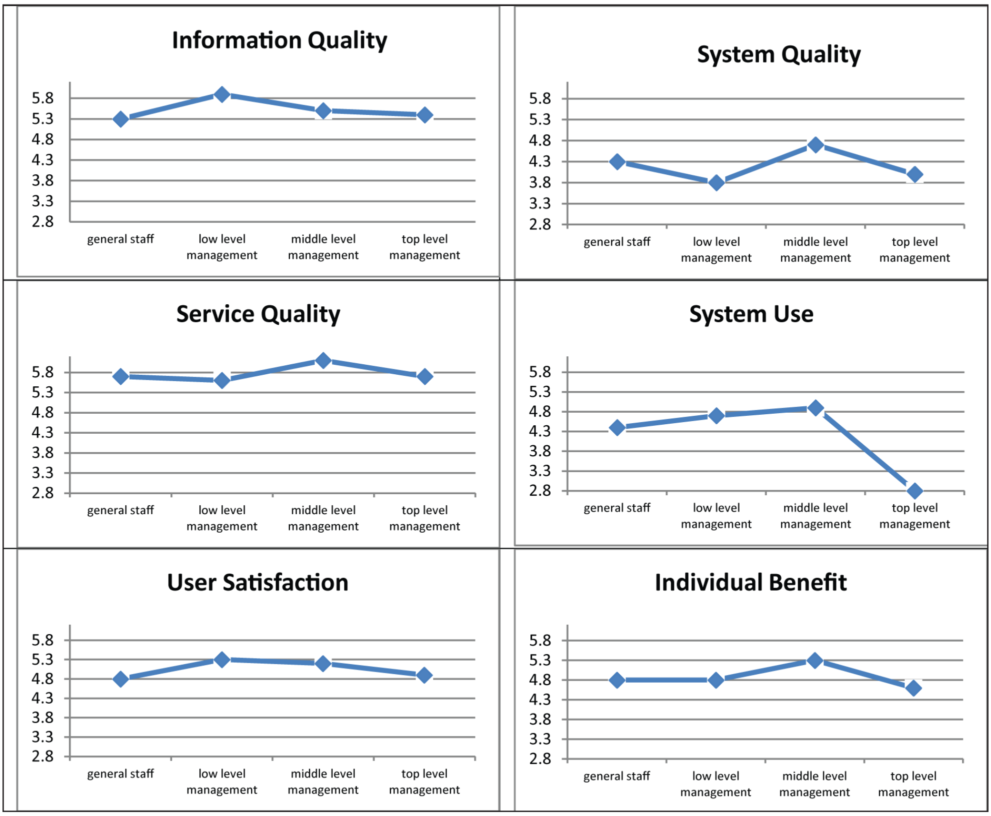
Descriptive Statistics

More than two thirds of the SAP system users had more than three years of work experience with the case company. Approximately 41.8% of the respondents held middle or top management positions; moreover, 23% of the respondents worked in the manufacturing department while roughly 51% were from the finance & IT, supply chain, technical service or capital equipment departments. In general, almost 80% of the respondents used three or more SAP modules regularly.

Figure 2 shows the trends, patterns and/or changes in the average scores (for several variables of interest) with respect to different job positions. Although no specific inferences can be made due to the type of data collected, we can observe that system use increased with job rank aside from those holding top level management positions. Interestingly, these top level management individuals also had the lowest user satisfaction and perceived individual benefits associated with the system. This suggests the relationship and association among ERP system use, user satisfaction and perceived individual benefit from the system.

These results could be due to varying job attributes and accountability: top level managers (e.g., from the Sales Management Department, Communications Department, and Marketing & Product Management Department)

Figure 2. Distribution of average scores across job position for different IS success factors



primarily downloaded management reports, which led to low perceived individual benefits. However, this observation is inconsistent with Holsapple et al. (2005), where top managers used the ERP system to obtain timely and integrated enterprise information. Thus, the perceived net benefit from an ERP system appears to depend on how the ERP system is used, rather than the management level of the users.

As illustrated in Table 4, the operational complexities of a functional-area/department positively correlated with the degree of system customization. A complex functional-area such as the Supply Chain Department used the SAP to manage their overall supply chain, from packaging material orders to production scheduling and plan design, stock management, and shipping management. In light of their complex operational characteristics, industry characteristics and multinational company characteristics, which are similar to global supply chain systems (Wang, Chan, & Pauleen, 2010), this department changed a lot of processes in the SAP and also customized the SAP in terms of design handling, order handling and claim handling. In contrast, the Human Resource Department, a functional-area involving less complex and no unique business operations, did not modify the HR module.

However, Table 4 also shows that greater customization did not show significant correlation with system quality (SQ), information quality (IQ), service quality (SE), data fit (DF), or process fit (PF). This is because functional-areas that have done a lot of customizations to the SAP modules tend to have data synchronization problems between the SAP system and one of their legacy systems, requiring significant

Table 4. Correlation matrix and AVE of principal constructs

	IQ	SQ	SE	US	PU	OC	PF	DF	UF	SA	CU	TR
IQ	**0.732**	.230*	.375**	.293**	.446**	.288**	.395**	.188	.275**	.576**	-.029	.229*
SQ		**0.758**	.444**	.513**	.570**	.239*	.212*	-.038	.195	.437**	.107	.186
SE			**0.677**	.399**	.435**	.232*	.245*	.086	.366**	.539**	-.107	.354**
US				**0.822**	.624**	.666**	.351**	-.021	.582**	.500**	.261*	.377**
PU					**0.841**	.551**	.323**	-.073	.436**	.760**	.188	.340**
OC						1.000	.332**	-.054	.639**	.516**	.283**	.675**
PF							**0.909**	.594**	.607**	.472**	.168	.375**
DF								**0.884**	.053	.103	-.175	.059
UF									**0.753**	.471**	.232*	.534**
SA										1.000	.044	.536**
CU											**0.883**	-.152
TR												1.000

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).
AVE (i.e., average variance explained) is shown in the matrix diagonal.

data accuracy and consistency maintenance by the IT department. Overall, the system users were unfamiliar with and required a lot of time to get used to the new SAP process.

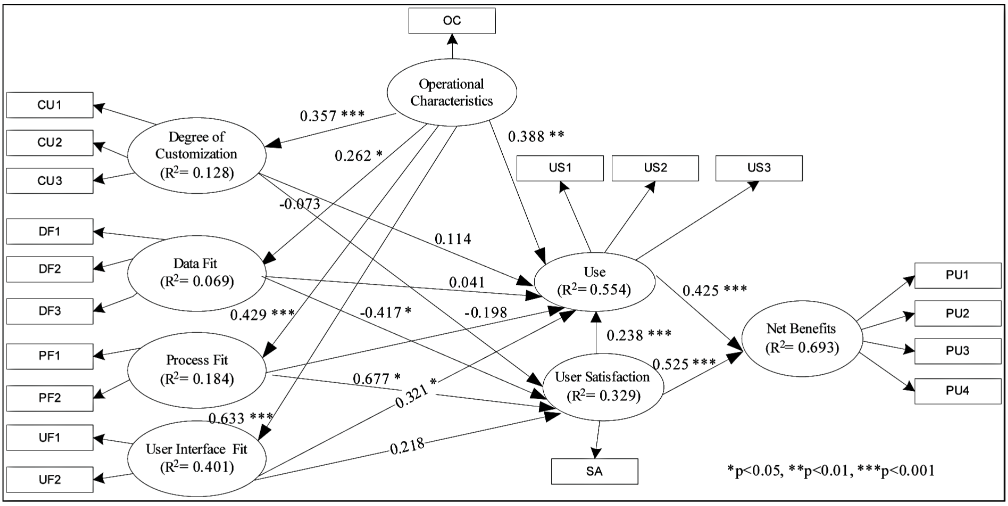
Still, the degree of customization moderately correlated with better user interface fit. User interface fit was the most strongly correlated with operational complexities, followed by process fit, while data fit did not exhibit any significant correlation. As such, in terms of our case company, the more complex the operational environment the greater the user interface fit and process fit.

Path Analysis Statistics

The number of indicators used for each construct is illustrated in Figure 3. The average variance extracted (AVE) for each construct as given in Table 4 was between 0.68 and 1, which is above the 0.5 threshold suggested by Fornell and Larcker (1981). Also, the square-roots of these AVE figures all exceeded 0.80. These are larger than all other cross-correlations noted in Table 5, and support that the variance explained by each construct exceeds the measurement error variance (Pavlou & Dimoka, 2006), which in turn validates the measurement properties of the constructs studied. As for internal consistency, the composite reliability values were between 0.86 and 1, which exceed the accepted threshold value of 0.7 as recommended in the literature (Fornell & Larcker, 1981; Nunnally, 1978). Thus, both the discriminant and convergent validity for the reflective constructs were satisfied.

Figure 3 presents the estimates obtained during the PLS analysis without considering the control variables. The R^2 value of 0.693 (Figure 4) suggests that the model explains a substantial amount of the variance for ERP system net benefits. From the model's path coefficient listed in Figure 3, we discover that business units with more complex operational characteristics call for a greater degree of customization, user interface fit, process fit, system use and data fit. As such, hypotheses H1a, H1b, H1c, H1d and H1e were supported, which answers the second research question. In turn, it seems that the ERP system is more suitable for complex business functional areas within a multinational environment, such as supply chains, finance & IT, technical service and capital equipment, even though these areas

Figure 3. Path analysis results without control variables



typically require some system customization; this supports the findings of Ragowsky and Gefen (2008).

Somewhat surprisingly, the empirical data does not support the notion that the degree of customization significantly influences user satisfaction or system use (Figure 3). Therefore, hypotheses H2a and H2b were not supported. As such, from the technical and system use perspectives, the degree of ERP system customization and/or modification does not have an impact on the ERP system net benefits.

Moreover, only user interface fit positively affected the ERP system use, and only process fit positively influenced the ERP system user satisfaction. These findings help to answer to the first research question. Thus, among hypotheses H3a, H3b, H4a, H4b, H5a, and H5b, only hypotheses H4b and H5a were supported. However, process fit and user interface fit were strongly affected by the operational characteristics of the business unit—almost 40.1% of the variance in user interface fit in the data was explained by the operational characteristics variable; this variable also explained 18.4% of the variance in process fit.

Additional Analysis of the Control Variables

Due to the limited sample size, a straightforward correlation analysis was conducted on the control variables in an effort to investigate the impacts of the control variables on the relationships between the five independent variables and the two dependent variables (i.e., system use and user satisfaction): the data sets were split into two subgroups composed of lower and higher values of the control variables based on their median values (Avolio, Howell, & Sosik, 1999). The subgroups for each control variable are shown in Appendix A. However, the sample size of the training upper subgroup differed from that of the lower subgroup by 1.76 times (58/33), which exceeded the recommended limit of less than 1.5 times (Stevens, 1996). Thus, the training control variable was excluded from the subsequent analysis; as such, only three control variables were examined in the correlation tests.

In light of the small sample size, a power analysis was also conducted using G*Power (Faul, Erdfelder, Buchner, & Lang, 2009). With a minimum sample size of 40 (the smallest sample size in the control variable subgroups), an alpha

Table 5. Correlation analysis

5-A. Information quality (IQ)								
	IQ-High							
	US	PU	SA	OC	PF	DF	UF	CU
US	1	.695**	.644**	.793**	.442**	.159	.662**	.143
PU	.631**	1	.726**	.630**	.215	-.023	.417**	.096
SA	.293	.716**	1	.624**	.228	-.041	.403**	-.050
OC	.551**	.420**	.341*	1	.464**	.227	.703**	.162
PF	.281	.436**	.636**	.359*	1	.870**	.626**	.238
DF	.144	.151	.245	.057	.643**	1	.388**	.341*
UF	.507**	.524**	.525**	.560**	.705**	.304	1	.169
CU	.548**	.323*	.371*	.530**	.620**	.371*	.565**	1
	IQ-Low							
5-B. Service quality (SE)								
	SE-High							
	US	PU	SA	OC	PF	DF	UF	CU
US	1	.662**	.538**	.714**	.280*	-.119	.466**	-.097
PU	.642**	1	.657**	.586**	.183	-.193	.315*	.005
SA	.392*	.736**	1	.620**	.537**	.063	.452**	-.059
OC	.641**	.499**	.425**	1	.460**	-.231	.641**	.139
PF	.374*	.344*	.319*	.400*	1	.303*	.523**	-.173
DF	.171	.011	-.035	.271	.832**	1	-.289*	-.545**
UF	.673**	.526**	.377*	.626**	.754**	.547**	1	-.069
CU	.712**	.410**	.371*	.585**	.763**	.597**	.772**	1
	SE-Low							
5-C. System quality (SQ)								
	SQ-High							
	US	PU	SA	OC	PF	DF	UF	CU
US	1	.421**	.194	.590**	.336*	.244	.550**	.289*
PU	.670**	1	.680**	.511**	.204	.013	.233	-.021
SA	.486**	.666**	1	.468**	.319*	.026	.225	-.215
OC	.755**	.535**	.478**	1	.506**	.262	.580**	.269
PF	.368*	.439**	.560**	.304	1	.772**	.583**	.355*
DF	.129	.146	.191	.055	.740**	1	.332*	.328*
UF	.653**	.686**	.656**	.694**	.762**	.391*	1	.305*
CU	.385*	.347*	.381*	.392*	.508**	.397**	.402**	1
	SQ-Low							
	* significant at the 0.05 level (2-tailed). ** significant at the 0.01 level (2-tailed).							

of 0.05 and a medium effect size (the ratio of effect size to variability) of 0.37, the level of power (i.e., the probability of correctly rejecting the null hypothesis) was computed to be 0.8, which represents an acceptable level of power in most social science research (Cohen, 1988).

In comparing the correlation results between high information quality (see the upper-part of Table 5-A) and low information quality (see the lower-part of Table 5-A), the correlations between (1) the degree of customization and system use, (2) the degree of customization and user satisfaction, and (3) process fit and user satisfaction were significant for the low information quality (IQ) group but not for the high IQ group. In particular, under the low IQ condition, the degree of customization was positively associated with system use and user satisfaction, and process fit was positively associated with user satisfaction. In contrast, process fit was significantly positively correlated with system use in the high IQ group.

ERP system use was strongly correlated with the degree of customization for the low service quality (SE) group compared to high service quality group (Table 5-B). However, the high SE group showed a higher and more significant correlation between ERP system user satisfaction and system use. User interface fit was positively correlated with user satisfaction for the low system quality (SQ) group but not the high SQ group (Table 5-C). For the low IQ, SE and SQ groups, the degree of customization was found to significantly and positively correlate with user satisfaction and the business unit's operational characteristics. Also, for the low IQ and SE groups, ERP system use increased together with the degree of customization. Overall, the analysis shows that different degrees of information quality, system quality and service quality had diverse effects on the relationships associated with the degree of customization, operational characteristics, process fit, user satisfaction and system use.

In an additional path analysis (not shown, which followed exactly the same DeLone and McLean IS success model), SQ was shown to be a significant variable that impacts both ERP system use and system user satisfaction: system quality alone explained 82.1% of the variance in ERP system use. ERP system use in turn impacted the perceived net benefits of the system. This result also coincides with Gable, Sedera, and Chan (2008). As such, both ERP system use and user satisfaction are important in terms of determining the perceived net benefit.

CONCLUSION AND IMPLICATIONS

The results of this case study contribute to a deeper understanding of how the degree of ERP customization, business unit characteristics and different types of ERP fit influence both user satisfaction with the system and system use. The empirical results indicate that the top-level managers in our study have lower perceived individual benefits and satisfaction with the ERP system. One top manager from the Human Resources Department stated: "HR only uses the personnel table in the system; however, this HR personnel table is very important, as it is used in almost all SAP processes and modules." This finding is inconsistent with prior research (Holsapple et al., 2005) regarding the association between management level and user satisfaction. We conclude that the perceived net benefits of an ERP system depend on how the ERP system is used, rather than the management level of the users (Figure 2).

Based on the data gathered across various business units, the empirical results show that the amount of ERP system customizations and/or modifications does not have a direct impact on ERP system success in terms of user satisfaction or system use. Also, greater customization does not exhibit significant correlation with system quality (SQ), information quality (IQ), service quality (SE), data fit (DF) or process fit (PF). For example, a key user from the Finance & IT Department stated: "[Although] the SAP is modified to meet local government requirements, especially for tax / VAT, we still require a lot of time to get used to the new [SAP] process and to teach people how to cooperate using the system … We must learn how to fit into the SAP process." This result is most likely due to the fact that customizations are not all linked to strategic business goals during the initial ERP implementation (see also Haines, 2009). However, this does not necessarily mean that the degree of customization cannot impact the strategic level of an organization if customizations can make the ERP system fit within the organization's hierarchical structure (Baker, 2006).

The empirical results suggest that more complex operational characteristics pertaining to a functional area are associated with greater customization, better user interface fit, better process fit, better data fit, and increased system use. This implies that ERP systems are more suitable for complex operational environments (e.g., a multinational's operational environment), which involve greater data input, data output, data processing and intra-business process interactions. This finding supports the claim by Baker (2006, p. 5) that "certain organizations will achieve short-term advantage from investing in ERP because their business structures have the best initial 'fit' with IT."

Implications for management – ERP implementation decisions are usually made by top management. Although any expected or unexpected "misfits" identified subsequent to the purchase decision can be discouraging, ERP client-organizations can still take corrective action by implementing the right ERP modules in the right business units, especially those with complex operational characteristics (as in a multinational company in this case), which are typically associated with significantly better user interface fit and process fit (Figure 3). In addition, management can ensure that appropriate ERP customization strategies are planned—they may address the user interface misfit in order to improve ERP system use, or address the process misfit to enhance user satisfaction with the ERP system. Management needs to pay particular attention to the ERP system quality in terms of ease of use and ease of learning, as this crucial variable impacts both ERP system use and user satisfaction.

As the degree of customization is not empirically found to enhance user satisfaction or system use, customizations should only be performed under stringent considerations. The experience in this case company shows that resolving misfits through customizations does not necessarily provide immediate remedies, as issues pertaining to system familiarity and learning, data synchronization and data consistency must be alleviated. Conversely, in order to minimize the complexity of future ERP upgrades associated with ERP customization and at the same time maintain system users' level of ERP system use, management can consider an upgraded/new version that incorporates business processes and user interfaces that fit system users' requirements (Figure 3).

Implications for research – This study investigates the impact of different business unit's characteristics on the degree of customization within a multinational company; future studies may consider a multilevel examination composed of individual, group and firm levels, using a multiple case comparison to understand what inter-organizational factors (a multinational company vs. an international company vs. a local company) influence ERP success within complicated organizational context and how this occurs. Researchers can also investigate how the amount of customization impacts other diversified organizations in terms of competitive power and financial performance. The interview data collected in the current study suggests that compared to employees who had not used the previous IS systems, employees who had used these systems prior to the new SAP ERP system were more likely to perceive that the ERP system was a good fit based on their operational characteristics, and were more satisfied with the ERP system. This indicates that respondents' prior experience with other IS systems and other institutional factors can influence their perceptions and beliefs regarding the new system. Similarly, the perceived benefits at different organizational levels are usually measured based on subjects' feelings; however, these perceived benefits may be affected by attitudes towards the system use, job functions, expectations, use intentions and other psychological factors. Future researchers may endeavor to control these factors to mitigate this limitation.

Limitations

This study has a number of limitations that warrant mention. First, the SAP implementation in this study is focused on a single firm. However, this type of case study is suitable for previously inaccessible data and helpful to uncover the *how*- and *why*-research questions that have not been answered in previous studies (Yin, 2003). As such, the research results are affected by the unique characteristics (a multinational company, company size, industry) of the case company. Also, the study results contribute beyond the theoretical realm: they provide some evidence for the relationships among variables such as operational characteristics, data fit, process fit, user interface fit and degree of customization and ERP system use, which are highly relevant to practical concerns within the complex ERP environment. Future studies should investigate a diverse range of additional companies to validate our findings.

Second, in addition to the software functionalities, the various packaged software applications have different attributes pertaining to solution maturity and system complexity (Haines, 2009). These differences are likely to generate diverse impacts and results based on the degree of customization required, system quality, information quality, and system usage at different levels in the organization. The case company in this study employs SAP R3/4.7 and the results listed here are limited to this context.

Thirdly, typical qualitative case studies are susceptible to perception bias (Pronin, 2006), case selection bias (Collinson & Rugman, 2010) and interpretative bias (Galliers, 1992). These biases are sometimes unavoidable due to possible conscious and/or unconscious distorted human judgment, research resource constraints, and the researcher's background, understanding and perceptions. However, these limitations can be mitigated through data triangulation (Eisenhardt, 1989; Yin, 2003); in this study, quantitative data is collected through surveys, and other data sources such as interviews and documentation are used as supporting evidence.

Finally, a few of the survey items required the respondents to remember events that happened during the ERP customization process; as such, their responses depend on the accuracy of their memories. However, multiple sources of evidence (e.g., interviews and archival records/documentation) are utilized in this study in an attempt to counteract this issue. Future studies can also investigate in detail whether differences in terms of user satisfaction, enterprise system success and system use exist for staff who have experience with both the legacy system and the new ERP system as compared to those who only have experience with the new system; in this way, the impact of a new system can be more meaningfully and accurately interpreted. We believe that the empirical findings in this study will help to reduce ERP project failure risk, select more suitable business units or functional areas to adopt relevant ERP modules, and result in better planning and decision-making on ERP misfit issues during future ERP upgrades.

ACKNOWLEDGMENT

This study was supported by two National Science Council grants: NSC 97-2410-H-155-033 and NSC 100-2410-H-155-012.

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APPENDIX A

Table 6. Subgroups of each control variable

	IQ (Mdn=5.5)	SE (Mdn=6)	SQ (Mdn=4.67)	TR (Mdn=5)
# of lower subgroup (< median)	42	40	42	33*
# of upper subgroup (>= median)	49	51	49	58

* The sample size of the training upper subgroup differs from the lower subgroup by 1.76 times (58/33), which exceeds the recommended limit of less than 1.5 times.

APPENDIX B

Table 7. Operational characteristic score definitions

7 = Extremely complex: involved inputting extremely large amounts of *data*, producing extremely large amounts of *reports*, processing extremely large amounts of *customer data* (e.g., accounts receivable and sales orders), processing extremely large amounts of *supplier data* (e.g., accounts payable and purchase orders), need to access extremely large amounts of *databases*, **and/or** the department's business processes need to *interact* with extremely large amounts of other *business processes from different departments*
6 = Very complex: involved entering very large amounts of *data*, producing very large amounts of *reports*, processing very large amounts of *customer data* (e.g., accounts receivable and sales orders), processing very large amounts of *supplier data* (e.g., accounts payable and purchase orders), need to access very large amounts of *databases*, **and/or** the department's business processes need to *interact* with very large amounts of other *business processes from different departments*
5 = Complex: involved entering large amounts of *data*, producing large amounts of *reports*, processing large amounts of *customer data* (e.g., accounts receivable and sales orders), processing large amounts of *supplier data* (e.g., accounts payable and purchase orders), need to access large amounts of *databases*, **and/or** the department's business processes need to *interact* with large amounts of other *business processes from different departments*
4 = I don't know
3 = Simple: involved entering small amounts of *data*, producing small amounts of *reports*, processing small amounts of *customer data* (e.g., accounts receivable and sales orders), processing small amounts of *supplier data* (e.g., accounts payable and purchase orders), need to access small amounts of *databases*, **and/or** the department's business processes need to *interact* with small amounts of other *business processes from different departments*
2 = Very simple: involved entering very small amounts of *data*, producing very small amounts of *reports*, processing very small amounts of *customer data* (e.g., accounts receivable and sales orders), processing very small amounts of *supplier data* (e.g., accounts payable and purchase orders), need to access very small amounts of *databases*, **and/or** the department's business processes need to *interact* with very small amounts of other *business processes from different departments*
1= Extremely simple: involved entering no *data*, producing no *reports*, processing no *customer data* (e.g., accounts receivable, sales orders), processing no *supplier data* (e.g., accounts payable, purchase orders), need to access no *databases*, **and/or** the department's business processes need to *interact* with no other *business processes from different departments*