



An Empirical Investigation on End-Users' Acceptance of Enterprise Systems

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ABSTRACT

Despite the huge investments by organizations in ERP implementation, maintenance, and user training, ERP implementation failures and less-than-satisfactory productivity improvements are common. End-users' reluctance or unwillingness to adopt or use the newly implemented ERP system is often cited as one of the main reasons for ERP failures. To examine factors leading to the lack of end-user acceptance of ERP systems, we reviewed the literature on user adoption of IT in mandatory contexts, developed hypotheses to explain ERP user acceptance, and conducted a survey study to test the hypotheses. In particular, we examined end-users' attitudes toward system use and symbolic adoption, which refers to users' voluntary mental acceptance of a system, to understand user acceptance in the ERP context. Four cognitive constructs—perceived usefulness, perceived ease of use, perceived compatibility, and perceived fit—were hypothesized as the antecedents. The research model was tested through a survey of end-users' perceptions concerning adopting and using a newly implemented ERP system. The findings support most of our hypotheses. Specifically, perceived compatibility and perceived ease of use have both direct and indirect effects (mediated by attitude) on symbolic adoption, while perceived fit and perceived usefulness influence symbolic adoption by being fully mediated through attitude. The study provides managerial implications for organizations that are striving to engender user acceptance of newly adopted enterprise systems and applications.

Keywords: compatibility; enterprise system; ERP; fit; perceived ease of use; perceived usefulness; symbolic adoption; user acceptance.

INTRODUCTION

Organizations are facing constant challenges in sustaining and gaining competitive advantage through adopting new information technologies, such as Enterprise Resource Planning (ERP) software. ERP systems provide an integrated enterprise-wide business solution to organizations to help achieve their competitive goals. By 2000, the ERP revolution generated over

\$20 billion in annual revenues for ERP suppliers, and an additional \$20 billion for consulting firms (Willcocks & Sykes, 2000). Despite the huge investments by organizations, there are many cases of implementation failures and less-than-satisfactory productivity improvements (see Davenport, 1998). One of the commonly cited reasons for ERP failures is end-users' reluctance or unwillingness to adopt or use the newly implemented ERP system (Barker &

Frolick, 2003; Krasner, 2000; Scott & Vessey, 2002; Umble & Umble, 2002; Wah, 2000). The lack of user acceptance can lead to rote rather than sophisticated use of the system and disgruntled morale problems in the organization. Therefore, a good understanding of end-users' acceptance of ERP systems is vital to ERP implementation success. A literature review of past ERP studies indicates that few studies have investigated end-users' acceptance of ERP systems. As large software packages gain popularity in organizations, this problem may become more acute over time. By drawing on established theories and empirical findings in information technology (IT) adoption to study factors influencing end-users' attitudes and acceptance of ERP systems, we attempt to fill this void in the literature and enhance the cumulative knowledge on ERP success. Specifically, we are interested in examining how end-users' cognitive considerations of the characteristics of an ERP system affect their attitude and voluntary mental acceptance of the system.

Our paper is organized as follows. First, we discuss the two main research approaches used in ERP studies and justify the approach used in this study. Then, we review the dominant IT adoption theories and studies that have examined users' acceptance in both voluntary and mandatory contexts, and discuss how they apply in the ERP context. Based on the relevant literature and theoretical foundation, we develop the hypotheses for this research. Through a survey of end-users' perceptions concerning adopting and using a newly implemented ERP system, we test the research hypotheses and discuss the implications of the results. The paper concludes with a discussion of the limitations and future research directions.

LITERATURE REVIEW

Enterprise Resource Planning (ERP)

An ERP system can be viewed as an enterprise-wide information system that integrates all aspects of a business. At the core of an ERP system is "a single comprehensive database, which collects data from and feeds data into modular applications supporting virtually all of a company's business activities—across functions, across business units, across the world" (Davenport, 1998, p. 123). In other words, the information associated with individual modules of ERP software is stored in a central database so that transactions or changes taking place in one module will automatically "trigger" related changes in other modules, and multiple departments throughout the organization can access the same data. Bingi, Sharma, and Godla (1999) and Nadkarni and Nah (2003) identified the main reasons companies adopt and implement ERP systems: integration of far-flung outposts of a company, sharing of information in a standard format across departments, replacement for legacy systems, and need for business process redesign.

The concept of ERP has emerged since the 1980s when large corporations implemented enterprise systems to integrate their internal functions. Research exists on a wide variety of subjects related to ERP systems, from decisions to implement such systems to choosing the software package, and the management, organizational, and technical issues in actual implementation, post-implementation, and beyond (Nah, Faja, & Cata, 2001). Researchers have also analyzed an assortment of impacts of the implementation process. Some general areas of focus include financial impacts,

organizational change, and theories of success. In addition, research has been conducted to compare and contrast ERP implementations in organizations of varying size and structure.

Robey, Ross, and Boudreau (2002) organized the academic research on ERP into two categories: variance research and process research. Variance research on ERP seeks to explain variation in outcome variables by associating those outcomes with antecedent conditions and predictor variables. Such studies include those on critical success factors of ERP implementation, and studies on effects of ERP implementation. Process research on ERP seeks to explain outcomes by examining sequences of events over time.

In this study, we are interested in identifying factors leading to users' (lack of) acceptance of ERP systems. Accordingly, our study can be classified as variance research because we want to identify factors that lead to variation in users' acceptance of ERP systems. As several studies (Barker & Frolick, 2003; Krasner, 2000; Scott & Vessey, 2002; Umble & Umble, 2002; Wah, 2000) have revealed, a common reason for ERP failures can be attributed to users' reluctance or unwillingness to adopt and use the newly implemented ERP system. Hence, a better understanding of factors leading to users' acceptance (or lack of acceptance) of ERP systems is necessary to facilitate successful ERP implementation and usage. Among the existing ERP studies, research on end-users' perceptions and attitudes on adopting and using ERP is scarce. To gain a more in-depth understanding of end-users' acceptance of ERP systems, we will first examine established theories relating to users' adoption of IT.

IT Adoption Theories

Extensive studies have been conducted to examine the primary drivers of user intentions to adopt new information technologies. Taylor and Todd (1995) summarized two lines of research in IT adoption. The first line is grounded in models from social psychology, such as the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980), the Theory of Planned Behavior (TPB) (Ajzen, 1985, 1991), and the Technology Acceptance Model (TAM) (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989). The second line of research is based on the Diffusion of Innovations (DOI) (Rogers, 1995). According to DOI, a variety of factors, including the characteristics of the technology (compatibility, complexity, relative advantage, etc.), the characteristics of the potential users (innovativeness, IT sophistication, etc.), and the characteristics of the contextual environment (external persuasion, competition, etc.) are considered determinants of IT adoption and usage.

As an adaptation of the TRA, TAM (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989) has emerged as a "powerful and parsimonious way to represent the antecedents of system usage through beliefs about two factors: the perceived ease of use and the perceived usefulness of an information system" (Taylor & Todd, 1995, p.145). Among the various theories that explain or predict user intentions to adopt new information technologies, TAM has witnessed substantial theoretical and empirical support (Venkatesh & Davis, 2000). TAM theorizes that "an individual's behavioral intention to use a system is determined by two beliefs: perceived usefulness, defined as the extent to which a person believes that using the system will enhance his or her job performance, and perceived ease

of use, defined as the extent to which a person believes that using the system will be free of effort” (Venkatesh & Davis, 2000, p.187).

According to TAM, perceived usefulness is also influenced by perceived ease of use because, other things being equal, the easier the system is to use, the more useful it will be (Davis et al., 1989). Many empirical tests of TAM indicate that perceived usefulness is a strong determinant of behavioral intention, while perceived ease of use is a relatively weak determinant of intention (Venkatesh & Davis, 2000). The original TAM (see Figure 1) depicts that attitude is a mediating variable between the two determinants and behavioral intention. Studies demonstrated that without the mediating attitude construct, the explanatory power of the model is equally good and the model is more parsimonious (Davis et al., 1989). As a result, it has be-

come a norm to exclude the attitude construct from TAM. Figures 1 and 2 show the original formulation of TAM and the parsimonious formulation of TAM.

Even though it is primarily adapted from TRA, TAM is quite similar to DOI. The TAM constructs, perceived usefulness, and perceived ease of use are similar to Rogers’ perceived relative advantage and perceived complexity (Moore & Benbasat, 1991). In other words, TAM essentially conceptualizes two critical characteristics of the technology as the determinants of a user’s attitude and adoption intention, which provides the social-psychological explanation of the actual adoption and usage behavior.

Specifically tailored for modeling user acceptance of information systems, TAM has great explanatory power (explaining about 40% of the variance in usage intentions and behavior, according to Venkatesh

Figure 1: Original Formulation of TAM

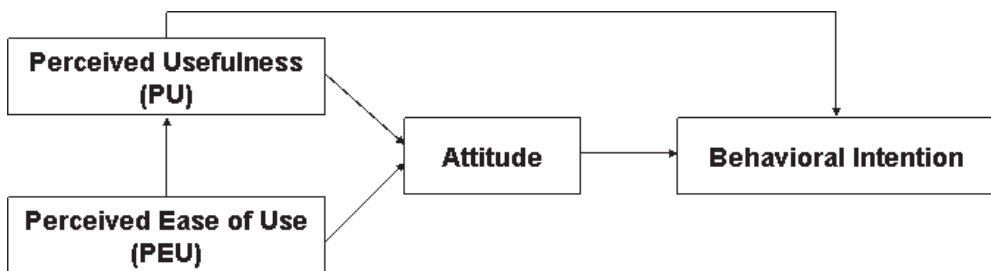
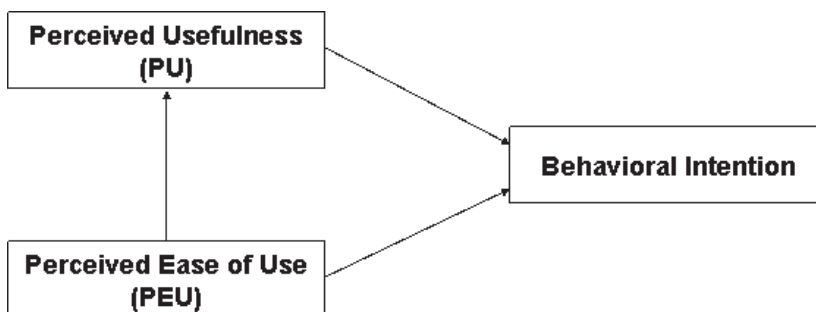


Figure 2: Parsimonious Formulation of TAM



& Davis, 2000). However, TAM by itself may not be suitable for explaining end-users' acceptance in the ERP context. We will articulate this point by referring to some existing studies on end-users' acceptance in ERP and similar contexts.

Existing Studies on End-Users' Acceptance in ERP & Similar Contexts

To assess whether TAM is suitable for explaining end-users' acceptance in the ERP context, we need to discuss the relevance and validity of the constructs and relationships defined by TAM in the ERP context. TAM has been tested primarily on the adoption of technologies that are relatively simple to use, such as email and word processors. ERP systems, however, are implemented in the organizational settings and are very complex to use. Several researchers (e.g., Adamson & Shine, 2003; Brown, Massey, Montoya-Weiss, & Burkman, 2002; Legris, Ingham, & Collette, 2003; Rawstorne, Jayasuriya, & Caputi, 1998) have pointed out that TAM needs to be extended or revised in order to explain end-users' acceptance of complex and advanced IT in organizational settings.

TAM postulates that behavioral intention is the main determinant of usage behavior and that any other factors that influence user behavior do so indirectly by influencing behavioral intention (Davis et al., 1989). However, an implicit assumption of TAM is that users of IT have a choice about the extent to which they use the technology. As a matter of fact, the majority of studies based on TRA, TPB, or TAM have been conducted in environments in which adoption was voluntary, as noted by Brown, Massey, Montoya-Weiss, and Burkman (2002) and Melone (1990). Such environments are very different from the ERP set-

tings. ERP usage is characterized as mandatory for its users (Pozebon, 2002). Brown and colleagues (2002) argued that ERP is a mandatory context where one user's tasks on the ERP system are tightly coupled and integrated with other users' tasks. In other words, one generally does not have the choice not to use the system, regardless of their attitude and mental acceptance of the system. Thus, to examine end-users' acceptance of ERP systems in the context of mandatory adoption and usage, we need to look beyond TAM.

Studies that predict or explain user adoption behaviors in the mandatory adoption and usage contexts have generally adopted one of the two primary approaches. One approach is to measure the extent of voluntariness or mandatoriness in cross-sectional studies, and treat it as a moderating variable that impacts the relationships between users' intentions and/or IS usage behavior and their antecedents. Some studies (Hartwick & Barki, 1994; Venkatesh & Davis, 2000) have shown that significant differences in the relationships among model variables exist due to the moderating effects of users' perceived voluntariness. A potential limitation of this approach is highlighted by Rawstorne, Jayasuriya, and Caputi (1998). They indicated that in a pure mandatory adoption setting, the user intentions construct, which is typically used as a gauge of usage behavior, is inappropriate because it would be extremely skewed and unusable in model testing.

Another approach of studying user adoption behaviors in the mandatory adoption and usage contexts is through single-case study, in which the adoption and usage of newly implemented information systems are mandated. Rawstorne et al. (2000) identified some issues in predicting and explaining usage behaviors when usage is

mandatory. The issues include: (1) limitation in line of inquiry, (2) issues in measuring usage behavior as the dependent variable, (3) operationalizing variables, and (4) sample constituency. To address these issues, Rawstorne et al. conducted a single-site, single-technology, longitudinal study. The outcome is mixed: while TAM and TPB were able to predict some specific behaviors, they failed to predict others. In other words, the link between behavioral intentions and actual behavior does not always hold in mandatory contexts. This result supports the notion that it is inappropriate to use behavioral intentions as a gauge of usage behavior in mandatory contexts. Brown et al. (2002) discussed and investigated these issues relating to user acceptance of mandated technology, including the nature of mandatoriness and the implications of users' attitude in technology acceptance. They further contended that behavioral intention is not appropriate for assessing users' acceptance of newly implemented information technology in mandatory contexts, as in the case of ERP. In their single-technology, multiple-sites (within a large holding company) study, Brown et al. found the absence of a relationship between attitude and behavioral intention. Their study provides another empirical support for the inappropriateness of using behavioral intentions as a dependent variable in mandatory contexts.

Several other studies (Karahanna, 1999; Rawstorne et al., 1998; Singletary, Akbulut, & Houston, 2002) also provide conceptual rationale and empirical support concerning the inappropriateness of using behavioral intention to predict or explain users' adoption and usage behavior in mandatory contexts. Table 1 summarizes the studies and their findings in predicting or explaining users' adoption behaviors in the mandatory adoption and usage contexts.

The mixed results from the cross-sectional studies (Hartwick & Barki, 1994; Venkatesh & Davis, 2000) and the evidence from the single-case studies (Brown et al., 2002; Rawstorne et al., 2000), together with the theoretical and conceptual articulations in other studies (e.g., Rawstorne et al., 1998; Singletary, Akbulut, & Houston, 2002), led us to contend that: (1) adoption intention may not be adequate or suitable to measure users' mental acceptance if the use is mandated, and (2) the attitude-intention-behavior relation may not hold in mandatory settings.

Among the limited studies that have examined the use of ERP systems by end-users, one study (Bagchi, Kanungo, & Dasgupta, 2003) has drawn extensively on the research model proposed by Hartwick and Barki (1994), and evaluated user participation and involvement in the ERP context. While we agree with Bagchi, Kanungo, and Dasgupta's (1993) conclusion that traditionally formalized links between antecedents of users' attitude and involvement may need to be revised in the ERP context, we are skeptical about the use and validity of the behavioral intention and usage behavior constructs. We adopt Rawstorne et al.'s (1998, 2000) view that these two variables may be highly skewed in the mandatory (e.g., ERP) context and thus are inappropriate for model testing. In addition, one of the research foci—the role of user participation—may not be as relevant or feasible in ERP implementation contexts. User participation refers to the behavioral engagement of users in IS development activities (Hartwick & Barki, 1994). Given that ERP software packages are off-the-shelf systems, user participation is generally limited to only a few users who are involved in software customization.

Considering that ERP usage is mandatory, Pozzebon (2002) proposed combin-

Table 1: Existing Technology Acceptance Studies on the Effect of Mandatoriness

Category	Studies	Assertions	Main findings
Cross-sectional study	Hartwick and Barki, 1994	Voluntariness and mandatoriness are treated as a moderating variable that may impact the relationships between behavioral intention/actual behavior and their antecedents.	<ul style="list-style-type: none"> For voluntary users, the overall responsibility component of user participation and user involvement is strongly linked to attitudes, norms, intentions, and use. For mandatory users, user participation and involvement are unimportant; instead, subjective norm has a significant effect on intention.
	Venkatesh and Davis, 2000		<ul style="list-style-type: none"> The direct compliance-based effect of subjective norm on intention will occur in mandatory, but not voluntary, system usage setting.
Single-case study (mandatory contexts)	Rawstorne et al., 2000	<ul style="list-style-type: none"> Whether or not an individual uses the technology is not a good dependent variable in mandatory contexts. Specific usage behaviors are more relevant. It is important to conduct usage research in a homogeneous context in which the use of IS has been mandated in respect to all research participants. 	<ul style="list-style-type: none"> TAM and TPB could not explain multiple usage behaviors. There is a danger in predicting intention only and using it to make conclusions about the determinants of that behavior in mandatory contexts. The findings support a necessary assumption that there is variance in mandated usage behavior. Usage behavior could be predicted to a reasonable degree after the commencement of use.
	Brown et al., 2002	<ul style="list-style-type: none"> Excluding the attitude construct from TAM will not provide an accurate representation of users' acceptance in mandated use contexts. Attitudes will not correlate with behavioral intention in mandatory contexts. 	<ul style="list-style-type: none"> Usefulness is the key antecedent of attitude. The relationship between attitude and behavioral intention is absent.

ing two distinct research streams—the structuration theory and the behavioral-based theories—in a qualitative study, and replaced the traditional behavior intention with a new construct called symbolic adoption, which refers to one's mental acceptance of an innovation (we will discuss this construct in detail later in the paper). The term "innovation dissonance" refers to the situation in which symbolic adoption is at odds with actual adoption (Rogers, 1995). When dissonance occurs, users are unlikely to invest time and effort to engage in discretionary constructive use of technology that is above and beyond prescribed work activities, thus limiting the overall potential benefits that can be derived from the system. Therefore, symbolic adoption is critical for users to engage in creative and qual-

ity use of the system.

Based on the aforementioned literature review, we conclude that:

- 1) Research that examines end-users' acceptance of ERP systems is scarce.
- 2) Of the limited number of studies on end-users' acceptance of ERP systems, few have sufficiently addressed the nature in ERP settings, where use is mandated.

In order to facilitate successful ERP implementation and usage, we propose a research model to further understand users' acceptance of ERP systems. The theoretical foundation for the proposed research hypotheses is discussed in the next section.

THEORETICAL FOUNDATION & RESEARCH HYPOTHESES

In this section, we discuss the theoretical foundation for the dependent variables and their antecedents, as well as the relationships between them.

Symbolic Adoption

The adoption and usage of ERP systems take place in a mandatory environment: in other words, the decision to adopt and implement an ERP system is often made by the management; end-users are mandated to use the ERP system to carry out their tasks, and the level of interdependence across departmental and functional boundaries is very high due to the integration. As discussed in the literature review, behavioral intention is not appropriate for understanding and predicting users' acceptance in mandatory adoption and usage contexts. The intention-behavior relation only applies when the behavior is under a person's volitional control (Ajzen & Fishbein, 1980). In addition, typical items used in questionnaires to probe users' behavioral intention, such as "Assuming I have access to the system, I intend to use it" or "I intend to use the system frequently in the next six months," seem to be irrelevant in the mandatory contexts (Rawstorne et al., 1998).

To address this issue, Rawstorne et al. (1998) and Karahanna (1999) suggested an alternative variable to substitute for behavioral intention—Symbolic Adoption (or SA for short)—in the mandatory context. Coined by Klonglan and Coward (1970), symbolic adoption refers to one's mental acceptance of an innovation, distinct from actual adoption which refers to actual use of technology. Karahanna (1999) asserted that symbolic adoption precedes actual

adoption and is a necessary but not sufficient condition for actual adoption in voluntary contexts. In the case of mandatory adoption, symbolic adoption is not necessary for actual adoption, but it is necessary for infusion. Rawstorne et al. (1998) contended that in a mandatory environment, people are likely to display differences in symbolic adoption of the new system. Identifying and analyzing such differences is likely to help predict initial resistance or lack of acceptance of technology in a mandatory adoption environment.

Therefore, we will use *symbolic adoption* as the primary variable for assessing end-users' acceptance of ERP systems in this study.

Users' Attitudes Toward System Use

Users may form attitudes toward using a system, which in turn influence their productivity through quality or amount of system usage and other important traits, such as job satisfaction and loyalty toward the organization. According to social psychology, attitude refers to the affect that one feels for or against some object or behavior (Ajzen & Fishbein, 1980). In IS research, a user attitude can be defined as "a predisposition to respond favorably or unfavorably to a computer system, application, system staff member, or a process related to the use of that system of application" (Melone, 1990, p. 81). As a strong relationship can be expected between attitude and performance of a particular behavior, attitude concerning system use has been extensively studied (e.g., Davis et al., 1989; Melone, 1990; Venkatesh, 1999, 2000).

Attitudes have been shown to correlate with behavioral intention in voluntary contexts. However, it may not be the case in mandatory contexts, such as in the case

of ERP. Brown et al. (2002) show that attitudes are not related to behavioral intention in a mandatory adoption environment. Other studies (Bagchi et al., 2003; Hartwick & Barki, 1994) reported contradictory results, which support the positive relationship between attitude and intention in mandatory contexts. We attribute the mixed findings to the inappropriate inclusion of the behavioral intention construct, which may be either highly skewed or irrelevant to research subjects and thus make the link unstable in the research model. As indicated by Rawstorne et al. (2000), the seemingly positive relationship may also have arisen due to "cognitive dissonance" in cross-sectional studies, causing respondents to psychologically associate intention with actual use.

The role of users' attitude in a mandated environment is important and should not be overlooked. Brown et al. (2002) specifically noted that excluding the attitude construct would not provide an accurate representation of users' acceptance of IT in the mandated adoption contexts. In this research, attitude is another dependent variable in our research model.

Consistent with earlier research, it is reasonable to assume that users' mental acceptance of an ERP system is highly influenced by their attitude toward using the system. That is, there is a positive relationship between attitude and symbolic adoption. Karahanna's (1999) study provides empirical evidence that users' attitude toward system use is a significant predictor of symbolic adoption. Hence, we hypothesize:

Hypothesis 1: Attitude toward system use will have a positive direct effect on symbolic adoption in the ERP context.

Antecedents: Cognitive Considerations

While users' attitude toward system use constitutes an affective dimension of symbolic adoption, other cognitive considerations are also important in determining one's symbolic adoption of an ERP system. Two important constructs in TAM—perceived usefulness (PU) and perceived ease of use (PEU)—may have direct effects on symbolic adoption. Karahanna's study (1999) provides empirical support for the direct effects (PU-SA and PEU-SA). Rawstorne et al. (1998) proposed that the effects of PU and PEU constructs on symbolic adoption are mediated by attitude, though these indirect effects have not been empirically tested. In this study, we hypothesize:

Direct Effects

Hypothesis 2: Perceived usefulness will have a positive direct effect on symbolic adoption in the ERP context.

Hypothesis 3: Perceived ease of use will have a positive direct effect on symbolic adoption in the ERP context.

Indirect Effects Mediated by Attitude

Hypothesis 4: Perceived usefulness will have a positive direct effect on attitude toward system use in the ERP context.

Hypothesis 5: Perceived ease of use will have a positive direct effect on attitude toward system use in the ERP context.

Perceived usefulness and perceived ease of use have been widely studied, based on the TAM, in general IT adoption settings. In the case of ERP implementations, which occur in organizational settings, other cognitive considerations may become rel-

evant by influencing one's attitude and symbolic adoption.

One attraction or major benefit of ERP is that it boasts the ability to offer companies best business practices. The true meaning of best practices is elusive, but Miranda (1999) cited several implications associated with the adoption of best practices (as defined by software companies), including promotion of standardized processes, organizational discipline, and cross-functionality. ERP implementations "force" organizations to streamline and standardize their processes across the organization and within individual business units. This characteristic of ERP systems is more than likely to create concerns among end-users about the compatibility and fit of the system.

According to Rogers' (1995) theory of Diffusion of Innovations, compatibility is defined as "the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs for potential adopters" (p. 224). Several studies (Agarwal & Prasad, 1997; Karahanna & Straub, 1999; Moore & Benbasat, 1991) have demonstrated that compatibility is an important factor in influencing end-users' attitudes in adopting or using a new IT. In the ERP context, we refer to perceived compatibility as the degree to which the ERP system is perceived to be consistent with past business processes that users have been accustomed to. As ERP implementations usually involve business process reengineering, end-users of ERP systems are likely to display strong variance in perceived compatibility, which in turn affects their attitude and symbolic adoption. Therefore, we hypothesize that:

Hypothesis 6: Perceived compatibility will have a positive direct effect on attitude toward system use in the ERP context.

Hypothesis 7: Perceived compatibility will have a positive direct effect on symbolic adoption in the ERP context.

The extent to which an ERP package encompasses the desired business processes for an organization is referred to as fit (Hong & Kim, 2002; Sieber, Siau, Nah, & Sieber, 2000). We define perceived fit from an end-user's perspective as the degree to which the ERP software is perceived by a user to meet his/her organization's needs. While fit-gap analysis is often conducted at the organization level (i.e., as part of the implementation process), individual end-users would cognitively process and perceive the fit at both the organizational and divisional (e.g., departmental) levels.

Soh, Kien, and Tay-Yap (2000) and Soh, Kien, Boh, and Tang (2003) used the terms "misfit" and "misalignment" interchangeably to refer to the situation where the company-specific, public sector-specific, or country-specific requirements did not match the capabilities of the ERP package. In their study (Soh et al., 2000), the observed misfits were clustered into three broad categories: data misfits, functional misfits, and output misfits. These misfits reflect a complex combination of compatibility and fit issues, which are often inevitable in ERP implementations because organizations often change their internal processes to fit the "industry best-practices" available in ERP software (Nah, 2003; Siau, 2004). Due to the nature of ERP software, organizations will try to customize the software as little as possible. Hence, the issue of perceived fit is likely to take on heightened importance and relevance in influencing end-users' attitude and symbolic adoption. Therefore, we hypothesize that:

Hypothesis 8: Perceived fit will have a positive direct effect on attitude toward system use in the ERP context.

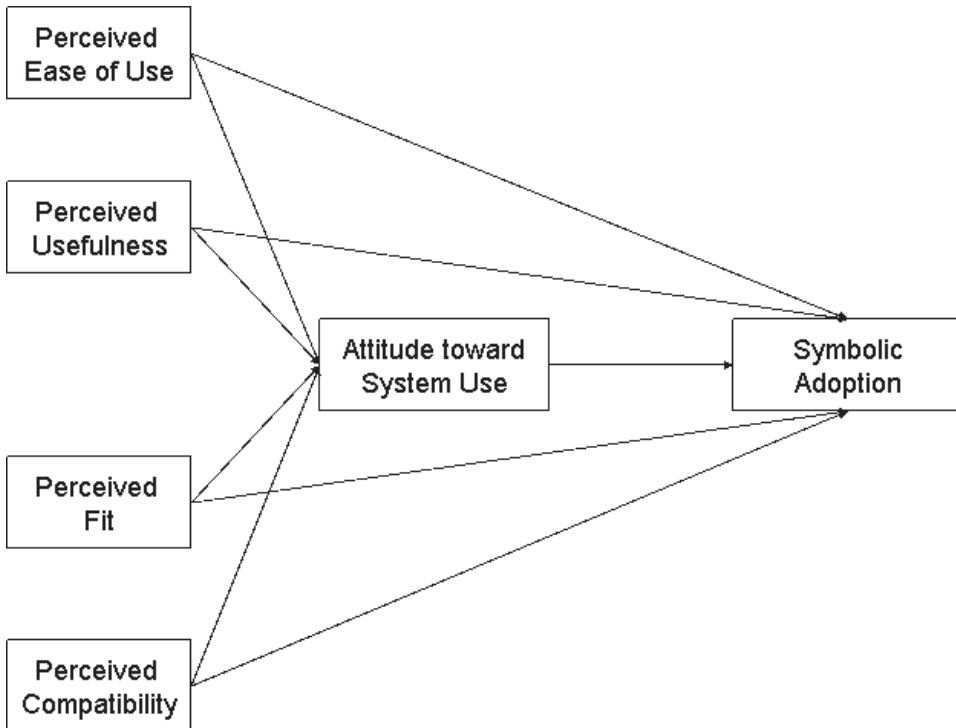
Hypothesis 9: Perceived fit will have a positive direct effect on symbolic adoption in the ERP context.

Based on the above discussions on the theoretical background and research hypotheses, we develop the research model as in Figure 3.

Our research model is an extension of the original formulation of TAM. In view of the deficiency and inappropriateness of using the behavioral intention construct in the ERP context, we replaced it with a more meaningful construct—symbolic adoption. In addition to the two primary determinants of TAM (perceived usefulness and perceived ease of use), we added perceived

compatibility and perceived fit because they are highly relevant and influential in the ERP context. It is apparent that the four antecedents reflect some characteristics of the technology (ERP) according to the notion of DOI. In this research, we are interested in examining which aspects of the characteristics of ERP software have an impact on end-users' acceptance. The effects of the characteristics of other factors (e.g., characteristics of users and contextual environment) are outside the scope of this paper. To focus on the key aspects of this research (i.e., assessing the impact of the four cognitive determinants on users' acceptance in terms of attitude and symbolic adoption) and to maintain parsimony of the model, the interrelationships among the four antecedents (exogenous variables) are not examined in this study.

Figure 3: Research Model



RESEARCH METHOD

The survey approach was used to test the research model. Survey questionnaires were sent to all the SAP users of one of the sites of a midwestern public institution in the U.S. that implemented SAP R/3. The SAP R/3 system went live in July 1999 to support the administration functions of the institution. At the time of initial implementation, five SAP modules were utilized: Financial Accounting (FI), Controlling (CO), Human Resources (HR), Materials Management (MM), and Project Systems (PS). Subsequently, the Asset Management (AM) and Treasury (TR) modules were implemented. Survey questionnaires for this study were sent out to the users around the end of 2000.

Instrument Development

We developed a survey questionnaire to capture each of the constructs in the research model (as shown in Figure 3). Most of the theoretical constructs were operationalized using validated items from prior research. The items measuring perceived usefulness, perceived ease of use, and perceived compatibility were derived from Taylor and Todd (1995). The items measuring attitude toward system use were adopted from Hartwick and Barki (1994). The items measuring symbolic adoption were adopted from Karahanna (1999). The two items for perceived fit were developed specifically for this study. The constructs were measured on a seven-point Likert scale (see Appendix).

Data Collection

Out of the surveys sent to all 525 SAP end-users, 229 usable responses were received, resulting in an overall response rate

of 44%. The majority of the SAP end-users were department secretaries, purchasing clerks, general clerks, and other clerical staff. Female users comprise 84% of the sample, which is consistent with the user population. In terms of education level, 75% of the respondents hold diplomas or bachelor's degrees. Most respondents (about 70% of them) have attended two to six (SAP end-user) training classes provided by the institution.

DATA ANALYSIS

Table 2 shows the descriptive statistics. As shown in Table 3, Cronbach's alphas range from 0.90 to 0.95, indicating very high reliability. The confirmatory factor analysis, also included in Table 3, demonstrates the convergent and discriminant validity of the constructs.

We conducted two multiple linear regressions to test our hypotheses ($\alpha=.05$). As shown in Table 4, the standardized coefficients of Regression Model 1 (i.e., with attitude toward system use as the dependent variable) indicate that Hypotheses 4, 5, 6, and 8 are supported. In other words, perceived usefulness, perceived ease of use, perceived compatibility, and perceived fit positively affect end-users' attitude toward system use. The four determinants jointly account for 61.9% of variance in attitude.

As shown in Table 5, the standardized coefficients of Regression Model 2 (i.e., with symbolic adoption as the dependent variable) indicate that Hypotheses 1, 3, and 7 are supported. In other words, perceived ease of use, compatibility, and attitude toward system use positively affect end-users' symbolic adoption. Hypotheses 2 and 9 are not supported, meaning that perceived usefulness and perceived fit do not have a positive direct effect on sym-

Table 2: Descriptive Statistics

	No. of Items	Mean	Std. Deviation	Minimum	Maximum
perceived usefulness	3	3.11	1.40	1	7
perceived ease of use	3	3.51	1.62	1	7
perceived fit	2	3.64	1.49	1	7
perceived compatibility	3	3.79	1.42	1	7
attitude toward system use	2	3.02	1.49	1	7
symbolic adoption	3	3.16	1.41	1	7

Table 3: Results of Confirmatory Factor Analysis and Reliability Analysis

	Perceived usefulness	Perceived ease of use	Perceived compatibility	Perceived fit	Attitude toward system use	Symbolic adoption
Cronbach's Alpha	.95	.94	.90	.91	.91	.91
perceived usefulness1	0.778	0.336	0.238	0.232	0.178	0.217
perceived usefulness2	0.845	0.234	0.186	0.184	0.103	0.271
perceived usefulness3	0.799	0.251	0.253	0.179	0.257	0.183
perceived ease of use1	0.273	0.778	0.236	0.212	0.195	0.262
perceived ease of use2	0.272	0.832	0.186	0.138	0.117	0.263
perceived ease of use3	0.285	0.760	0.274	0.205	0.242	0.277
perceived compatibility1	0.233	0.220	0.819	0.248	0.034	0.172
perceived compatibility2	0.316	0.257	0.673	0.223	0.323	0.327
perceived compatibility3	0.252	0.343	0.638	0.152	0.395	0.333
perceived fit1	0.246	0.221	0.251	0.741	0.283	0.328
perceived fit2	0.339	0.273	0.319	0.721	0.175	0.225
attitude1	0.239	0.211	0.181	0.303	0.785	0.320
attitude2	0.299	0.362	0.243	0.161	0.626	0.460
symbolic adoption1	0.222	0.311	0.181	0.166	0.240	0.793
symbolic adoption2	0.303	0.338	0.178	0.208	0.215	0.764
symbolic adoption3	0.169	0.165	0.251	0.200	0.177	0.770

Rotation Method: Varimax with Kaiser Normalization; The factor loadings for each item on its construct are in bold.

bolic adoption. The five determinants jointly account for 65.4% of variance in symbolic adoption.

In order to obtain more precise estimates of these significant effects, regressions omitting non-significant variables were run, and the results are shown in Figure 4.

DISCUSSION OF RESULTS

In this study, we developed our research model based on the review of literature on users' acceptance of IT in man-

datory contexts. We conducted a survey of end-users' perceptions about using a newly implemented ERP system to test the hypotheses related to our model. By contrasting the results of our study with prior research, we draw conclusions concerning enterprise system adoption in the mandatory context and discuss the implications of our findings.

Attitude Toward System Use

As shown in the final model (Figure 4), the basic relationships (PU-Attitude,

Table 4: Standardized Regression Coefficients

	Beta	t	Sig.	Hypothesis	Supported?
perceived usefulness	.160	2.499	.013	4	Yes
perceived ease of use	.219	3.459	.001	5	Yes
perceived compatibility	.229	3.363	.001	6	Yes
perceived fit	.292	4.453	.000	8	Yes

Notes: Dependent Variable — attitude toward system use; Adjusted R square: .619; Regression Sig.: .000

Table 5: Standardized Regression Coefficients

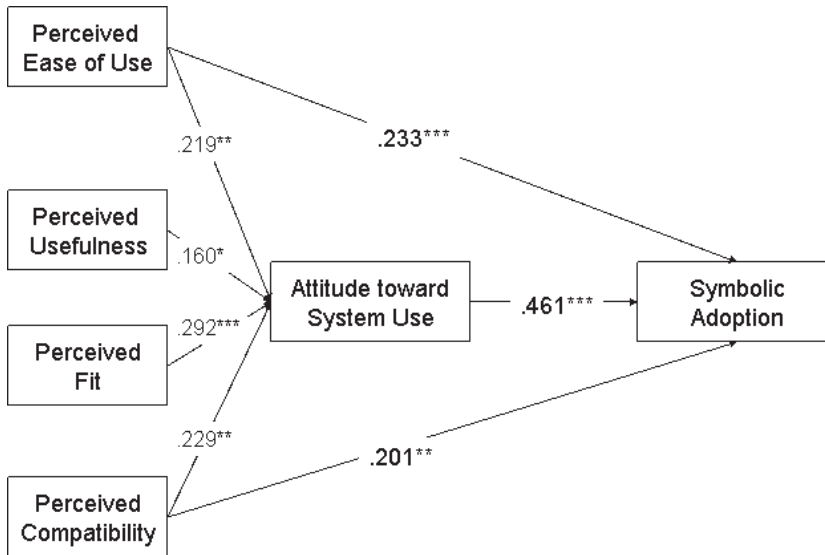
	Beta	t	Sig.	Hypothesis	Supported?
perceived usefulness	.041	.669	.504	2	No
perceived ease of use	.203	3.227	.001	3	Yes
perceived compatibility	.141	2.079	.039	7	Yes
perceived fit	.121	1.853	.065	9	No
attitude toward system use	.412	6.468	.000	1	Yes

Notes: Dependent Variable — symbolic adoption; Adjusted R square: .654; Regression Sig.: .000

PEU-Attitude) of the original TAM are found to be significant, which are in line with prior empirical studies (Davis et al., 1989; Mathieson, 1991; Taylor & Todd, 1995). In addition, our results also show that two additional determinants—perceived fit and perceived compatibility—account for a significant amount of variance in attitude. These two determinants have higher standardized coefficients than PU and PEU, suggesting that they have higher explanatory power than PU and PEU in the ERP context. A plausible explanation is that most of the prior studies (i.e., Davis et al., 1989; Mathieson, 1991; Taylor & Todd, 1995) were conducted in voluntary end-user computing contexts where users' perceived usefulness and ease of use are the primary factors in forming their attitude toward using the system. In the case of ERP, usefulness and ease of use cannot sufficiently explain end-users' attitudes toward using the new system. Instead, the issue of compatibility and fit is of

heightened relevance and importance because organizations implementing ERP systems often change their business processes to fit the software in order to take full advantage of the "best practices" offered by the ERP system (Nah, 2003; Nah, Zuckweiler, & Lau, 2003; Siau, 2004). It is a difficult balancing act for the management of organizations to optimize their investment in ERP software through business process reengineering (Siau, 2004). End-users may bear different feelings toward the heightened responsibility and accountability through the reengineering process. For some end-users, the added responsibility and accountability through business process reengineering are regarded as an element of empowerment (Shang & Seddon, 2000); for others, they may be regarded as a significant job burden. Therefore, users' beliefs concerning compatibility and fit are highly relevant in forming their affective feelings toward using the new system.

Figure 4: Final Model with all Significant Relationships



Notes: Adjusted R-square for attitude: 0.619, Adjusted R-square for symbolic adoption: 0.649; * $<.05$, ** $<.01$, *** $<.001$

Symbolic Adoption

The final model (Figure 4) also indicates that perceived ease of use, attitude, and compatibility are significant determinants of symbolic adoption, with attitude as the primary determinant. This result, as well as the discriminant validity shown earlier (Table 3), provides support for the assertion by Rawstorne et al. (1998) and Karahanna (1999) that attitude and symbolic adoption are two distinct constructs. While attitude toward system use is the key driver of symbolic adoption, both compatibility and perceived ease of use also have direct positive effects on symbolic adoption. On the other hand, perceived usefulness and fit affect symbolic adoption only through attitude. This finding casts some light on our understanding of end-users' acceptance of enterprise systems in mandatory usage contexts. Prior studies often use behavioral intention as the criterion vari-

able, which may not be appropriate when system use is mandated. Symbolic adoption—the degree of voluntary mental acceptance of the idea component of an IT innovation—may well be a more appropriate construct to explain IT adoption when usage is mandated (Karahanna, 1999). Together with the findings of Brown et al. (2002), which demonstrate the lack of relationship between attitude and behavioral intention in mandatory contexts, our results provide another support for using symbolic adoption to assess end-users' acceptance.

In sum, our findings show a different pattern of relationships between important cognitive beliefs and users' acceptance constructs (attitude and symbolic adoption), as compared with prior studies that were conducted mainly in voluntary contexts. Our findings have significant implications for organizations striving to engender positive attitudes toward newly adopted, enterprise-wide software packages and mandatory

applications. In order to create positive mental acceptance among end-users, organizational interventions should also focus on the issue of compatibility, which has both direct and indirect effects on symbolic adoption, as well as the issue of technology fit with organizational context, which influences symbolic adoption through attitude.

In order for an ERP system to be accepted by its end-users, the system must not only be perceived as useful and easy to use, it is also important that the end-users perceive the system to be compatible with their values and past experiences, and to be a good fit with the organizational context. Organizational fit with ERP is critical and has been found to be a critical success factor of ERP implementation (Hong & Kim, 2002).

User acceptance is necessary for effective use and appropriation of an ERP system, so organizations can gain maximum benefits from the system (Boudreau, 2003). For an ERP system to be perceived as useful and easy to use, training must be provided to the end-users. In order for end-users to understand the system and perceive it to be compatible with their values and past experiences, ample training and hands-on experiences are needed. Such training should not only focus on the key-strokes and procedures to complete the transactions, but should also provide users with a high-level view and understanding of the business process and their corresponding mappings to the system procedures. If the mappings between the business process and the current and previous procedures are apparent to users, they are more likely to perceive the ERP system to be compatible with their previous experiences. Hence, end-user training should be designed in such a way that it covers the different levels of abstractions and map-

pings between the business processes and the ways they are represented in the ERP system.

Users also need to perceive a fit between the ERP software and the business and organizational needs for them to accept the system. One way to achieve fit is to involve functional experts in the selection and evaluation of the ERP software package. Another complementary approach is to carry out a fit-gap analysis (Nadkarni & Nah, 2003; Sieber et al., 2000) to thoroughly understand the fits and the gaps between the available ERP software packages and the needs of the organizations before selecting the package that fits the best. Appropriate customization should also be carried out to achieve optimal fit.

LIMITATIONS & FUTURE RESEARCH DIRECTIONS

This study tested the proposed model in a large public institution system that implemented an ERP system. The findings from the statistical analyses reveal some differences in explaining users' acceptance of IT in mandatory contexts vis-à-vis in voluntary contexts, which have been studied extensively in the MIS literature. This study, however, is not without limitations. First, this study was conducted in a non-profit organization. Hence the issue of generalizability may be of concern. Future research is needed to examine users' acceptance, including attitude and symbolic adoption in other organizational settings. Second, the focus of this study was limited to examining the characteristics of the technology as cognitive antecedents of users' acceptance of ERP systems. In other words, it does not include characteristics of the users (e.g., innovativeness, IT sophistication) and characteristics of the environment (e.g., subjective norms). The

relationships between the key determinants examined in this study, the antecedents of those determinants, as well as the effects of other constructs (subjective norms and behavioral control) on users' acceptance warrant further research. In fact, several researchers have studied the determinants of perceived ease of use (see Venkatesh, 1999, 2000; Venkatesh & Davis, 1996) and perceived usefulness (Venkatesh & Davis, 2000). Third, because this is a cross-sectional study, the dynamics of users' acceptance may not have been fully investigated. Future research, preferably using longitudinal studies, may address the temporal dynamics of user acceptance. Lastly, due to privacy and confidentiality concerns, and the lack of validated measures of usage behavior in mandatory contexts (Rawstorne et al., 2000), our study did not directly measure end-users' usage behavior. Future research is needed to develop valid measures for usage behavior and to integrate the symbolic adoption construct in a nomological network to explain adoption and usage of an IT innovation in mandatory settings (Karahanna, 1999).

CONCLUSIONS & IMPLICATIONS

To address the key issues in end-users' acceptance of complex, integrated, enterprise-wide information systems such as ERP, researchers are thriving in two fronts. Some researchers attempt to effectively conceptualize and operationalize the variable of system use. For instance, Straub, Limayem, and Karahanna (1995) claimed that the wide variation of system usage measures hinders the efforts of MIS researchers to compare findings across studies. Their study reveals the difference between self-reported and computer-reported system use. Saga and Zmud (1994) classi-

fied system use based on three levels of infusion: extended use, integrative use, and emergent use. They stressed the infusion of technology as a key variable, i.e., the extent to which an innovation's features are used in a complete and sophisticated way. More recently, Boudreau (2003) emphasized the quality of use, which refers to one's ability to correctly exploit the appropriate capabilities of a software system in the most relevant circumstances. In another front, some researchers focus on users' acceptance of an IT innovation, which is a key factor influencing effective system use. Symbolic adoption (Karahanna, 1999) is conceptualized as one measure of users' mental acceptance and is proposed to replace adoption intention in contexts where use is mandated. Its determinants may include attitude, the characteristics of the technology, the characteristics of the users (Agarwal & Prasad, 1997), such as self-efficacy, and the characteristics of the contextual environment (Siau & Messersmith, 2003), such as subjective norms and facilitating conditions.

Accordingly, the present study can be classified in the latter group. The results of this study provide some empirical support for the construct of symbolic adoption. In addition, we investigated the impact of the characteristics of technology on users' attitude and symbolic adoption. The findings also have significant managerial implications on successful implementation of ERP systems, which is more complex and integrated than many other types of systems.

In conclusion, users' acceptance of ERP systems remains a complex and important phenomenon. Future research is needed to investigate other factors that contribute to ERP user acceptance, and to study the importance and consequences of end-user acceptance in the ERP context.

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APPENDIX — SURVEY QUESTIONNAIRE

<i>Strongly Agree</i>	<i>Somewhat Agree</i>	<i>Agree</i>	<i>Neutral</i>	<i>Somewhat Disagree</i>	<i>Strongly Disagree</i>	<i>Disagree</i>
1	2	3	4	5	6	7

Perceived Usefulness

1. Using the SAP system will make my work more efficient.
1 2 3 4 5 6 7
2. Using the SAP system will increase my job performance.
1 2 3 4 5 6 7
3. Using the SAP system will increase the productivity of my work.
1 2 3 4 5 6 7

Perceived Ease of Use

1. My interaction with the SAP system is clear and understandable.
1 2 3 4 5 6 7
2. It is easy for me to remember how to perform my regular job assignments using the SAP system.
1 2 3 4 5 6 7
3. Overall, I find the SAP system easy to use.
1 2 3 4 5 6 7

Perceived Compatibility

1. The setup of the SAP system is compatible with the way I worked before.
1 2 3 4 5 6 7
2. Using the SAP system is compatible with the way I like to work.
1 2 3 4 5 6 7
3. The setup of the SAP system is compatible with my style of work.
1 2 3 4 5 6 7

Perceived Fit

1. The SAP system fits well with the business needs of my campus.
1 2 3 4 5 6 7
2. The SAP system fits well with the business needs of my department.
1 2 3 4 5 6 7

Attitude Concerning System Use

1. Using the SAP system is a good idea.
1 2 3 4 5 6 7
2. I like the idea of using the SAP system to perform my job.
1 2 3 4 5 6 7

Symbolic Adoption

1. I am enthusiastic about using the SAP system.
1 2 3 4 5 6 7
2. I am excited about using the SAP system in my workplace.
1 2 3 4 5 6 7
3. It is my desire to see the full utilization and deployment of the SAP system.
1 2 3 4 5 6 7

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