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Explaining Employees Extended Use of Complex Information Systems

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Abstract

Investments in complex information systems by organizations reached a record high of US$ 26.7 billion in 2004. Yet, organizations seldom use these systems to the fullest extent and attain the expected return on investment. This paper addresses the issue of system underutilization by investigating Extended Use, which refers to using more system features to support one's tasks. Extended Use was examined in the nomological networks of the IS Continuance (ISC) model and Technology Acceptance Model (TAM).

A field survey was conducted in a large manufacturing firm that had successfully implemented a popular ERP solution for more than two years. All paths in both ISC and TAM were statistically significant. A synthesized model was later proposed and examined in a post-hoc analysis. The results indicate that the synthesized model, as compared to ISC and TAM, explained slightly higher variances in Extended Use, Perceived Usefulness, and Satisfaction. Specifically, Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) both affected Extended Use. Interestingly, Satisfaction has no direct impact on Extended Use in the presence of PU and PEOU. In contrast to most technology acceptance research, PEOU has a stronger behavioral impact than PU. This research provides a framework that explains Extended Use and is one of the few studies that investigates IS use behavior that exceeds simple, shallow, and routine use.

Keywords: extended use; technology acceptance model; IS continuance model; infusion

Motivation for the Study

Modern organizations are making significant investments in complex information systems (CIS). Complex information systems in this paper refer to large organizational information systems that integrate and streamline business processes across various functional departments/areas, such as the enterprise resource planning (ERP) systems (Al-Mudimigh et al., 2001; Bagchi et al., 2003; Gulla, 2004; Ko et al., 2005). For example, worldwide organizations spent $20 billion in total to adopt and implement ERP systems in 2000 (Willcocks & Sykes, 2000). Such investments increased to $26.7 billion in 2004 and are expected to rise to $37 billion in 2008 (Kawamoto, 2004). ERP project implementation in a large organization can easily cost more than $100 million (Robey et al., 2002; Seddon et al., 2003). However, the results of these initiatives are often rather disappointing. Nearly half of these projects experienced failures (Adam & O'Doherty, 2003). And organizations that implement ERP rarely use their systems to the fullest potential and realize the promised return on investment (Jasperson et al., 2005). This underachievement can be partially attributed to underutilization of the implemented systems. To address this issue, this research turns to the notion of Extended Use, the use behavior that goes beyond typical usage and can potentially lead to better results and returns. In this paper, Extended Use refers to using more of the technology's features to support an individual's task performance.

It is noted that a majority of technology acceptance research focused on the simple dichotomous adoption decision or amount of usage, such as frequency, time, and extent of use (Chin & Marcolin, 2001). This limited theoretical attention, to a certain degree, explains our insufficient knowledge about the reasons for system underutilization. Some IS researchers have acknowledged this situation and called for expansion of the scope of research from simple and superficial usage behavior to more sophisticated and deeper levels (Chin & Marcolin, 2001). Meanwhile, the sheer complexity and malleability of these

complex information systems permit users to utilize the systems at different levels of sophistication (Moore, 2002). Unfortunately, available evidence suggests that the functional potential of these applications is often underutilized: users may use only a limited number of available features or seldom apply task-related features to relevant operations (Davenport, 1998; Ross & Weill, 2002). Therefore, a more sophisticated usage concept that relates system features to task performance, i.e., Extended Use, represents a valuable perspective for achieving the fullest potential of a complex information system.

In addition, to identify the frameworks and factors that best describe Extended Use, this paper refers to two theoretical models for IS acceptance: the Technology Acceptance Model (TAM) (Davis et al., 1989) and the IS Continuance Model (ISC) (Bhattacherjee, 2001). TAM has received tremendous attention and has empirically demonstrated its capability in predicting IS usage in various contexts (Legris et al., 2003). It is perhaps one of the most parsimonious models to date that provides consistent results in explaining technology acceptance. On the other hand, Bhattcherjee (2001) proposed the IS Continuance model to explain usage behavior after initial use. A higher level of use behavior, such as Extended Use, is suggested to take place after individuals have passed their initial use stage and have attained routine use (Saga & Zmud, 1994). As a result, Extended Use is also examined in the nomological networks of TAM and ISC.

This research represents one of the few studies that investigate IS use behavior that exceeds simple, shallow, and routine use. The two models were examined empirically, utilizing data from a field survey of employees using an ERP system in a large manufacturing organization. A synthesized model was later proposed and evaluated in a post-hoc analysis.

Theoretical Background

Extended Use

Cooper & Zmud (1990) introduced a six-stage model of the IS implementation process: initiation, adoption, adaptation, acceptance, routinization, and infusion. The last three stages refer to different levels of implementation activities. *Acceptance* reflects users' commitment to use the system. *Routinization* describes the state where system use is no longer perceived as out-of-ordinary but actually becomes institutionalized. *Infusion* refers to the process of embedding an IT application deeply and comprehensively within an individual's or organization's work systems (Cooper & Zmud, 1990; Saga & Zmud, 1994). Through direct experience and the learning processes accumulated in prior stages, employees who attain the routine stage have the potential to use the system in a more comprehensive and sophisticated manner. When employees use IS in a way that goes beyond routine and standardized usage, they achieve a higher level of usage that may allow them to exploit the fullest potential of the system, resulting in more positive organizational consequences (Cooper & Zmud, 1990). Towards this end, researchers have proposed a few concepts that represent such non-routine usage, including the concept of Extended Use.

Saga & Zmud (1994) first described Extended Use as individuals using more of the technology's features in order to accommodate a more comprehensive set of work tasks. Researchers found that users often struggle with understanding how to use the system to support their jobs in the system implementation process. At first, they use a small number of system functions; but over time, they will find additional useful features (Robey et al., 2002). In other words, users experience simple and shallow usage when initially accepting the IS. After obtaining more experiences, they gradually progress into the routine stage in which system usage is no longer perceived as new or out of the ordinary (Saga & Zmud, 1994). As users become familiar with the system, they might not be contented with the current use

situation and may find more useful functionalities to support their work. Extended use occurs after routine use (Saga & Zmud, 1994). Schwarz (2003) later proposed a related concept, Deep Usage, which is defined as the extent of use of different technology functionalities. In abstract, the aforementioned two concepts generally refer to the act of using more functions in an information system. Given that technology usage should facilitate accomplishment of tasks by individuals in the organizational context, it is imperative to link IS use to task performance. Beyond supporting a more comprehensive set of work tasks, as suggested by Saga and Zmud (1994), the additional system features employed in Extended Use behavior may also be applied to existing tasks; as some tasks may be accomplished through the application of different features. Therefore, adapting the conceptualization by Saga and Zmud (1994), this paper refers to Extended Use as using more of the technology's features to support an individual's task performance. The task performance here includes both existing tasks and a more comprehensive set of work tasks.

TAM

Technology acceptance is one of the most studied streams in the field of IS. Among the many proposed theoretical frameworks for technology acceptance, TAM is perhaps the one that has received the most attention (Legris et al., 2003). Findings in prior research have offered consistent support for TAM's ability in explaining individual IS usage.

TAM posits two perceived technology attributes—Perceived Usefulness (PU) and Perceived Ease of Use (PEOU)—as the key factors affecting individual acceptance (Davis et al., 1989). In the original TAM, Behavioral Intention (BI) is determined by Attitude towards technology use, as well as by the direct and indirect effects of PU and PEOU. Behavioral Intention, in turn, directly influences use behavior. In a post hoc data analysis, Davis et al. (1989) recommended dropping Attitude and focusing on only three constructs: BI, PU, and PEOU. Following the work by Davis et al., some researchers proposed a more parsimonious

version of TAM, in which they ignored the mediating constructs (i.e., Attitude and BI), and measured only the direct effect of PU and PEOU on use behavior (e.g., Igbaria et al., 1997; Lucas & Spitler, 1999). This simplified TAM (Figure 1) suggests that both PU and PEOU are important determinants of system usage. In addition to the direct impact on Use, PEOU is also expected to influence PU positively. In this paper, Extended Use is examined in the nomological network of the simplified TAM.

Although TAM was originally developed to explain users' initial IT acceptance, some researchers have assumed that factors affecting initial acceptance would be similar to those affecting continued usage (Mathieson, 1991; Taylor & Todd, 1995). Similarly, some prior studies employed existing technology acceptance theories to explain the continued usage behavior (Karahanna et al., 1999; Parthasarathy & Bhattacherjee, 1998), viewing continuance as an extension of acceptance behavior. Moreover, among the technology acceptance studies, TAM has empirically demonstrated its capability in predicting initial IS usage as well as use behavior occurring long after initial usage (Legris et al., 2003). This suggests that it is appropriate to study Extended Use through the lens of TAM.

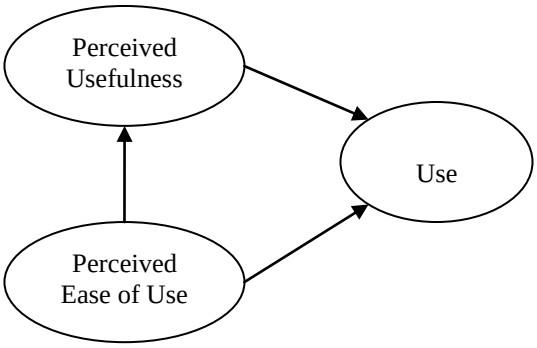

Figure 1 TAM Model

IS Continuance Model

Alternatively, drawing upon the expectation-confirmation theory, Bhattacherjee (2001) developed an IS continuance model (Figure 2) to explain individual use behavior after users have exceeded their initial usage. Bhattacherjee (2001) argued that initial use does not

represent continued use. He stated that it is the continued use, rather than initial use, that is more essential for the system's success. He also contended that after initial usage, cognitive beliefs like individual perception of system usefulness may change, and that such personal affects as Satisfaction will emerge and become a salient behavioral determinant.

The ISC model posits that users' IS Continuance Intention is determined primarily by their Satisfaction with prior use of the system. User Satisfaction is shaped by PU and Confirmation of Expectation (COE) following actual use. The model also posits that PU directly influences IS Continuance Intention. In addition, users' extent of Confirmation of Expectation positively influences PU.

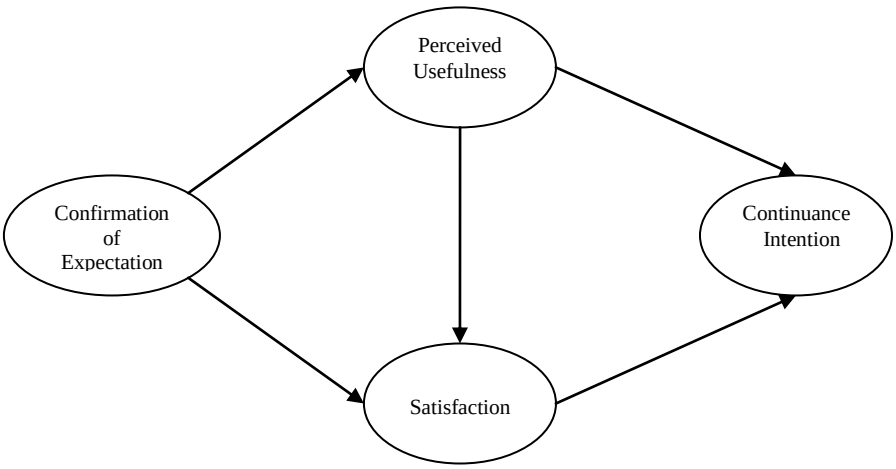

Figure 2 IS Continuance Model

Acknowledging the previously discussed conceptualization of IS implementation processes by Zmud and his colleagues, Bhattacherjee (2001) distinguished initial use during the acceptance stage from continued use at the post-acceptance stage. Conceptually speaking, the post-acceptance stage described by Bhattacherjee (2001) encompasses the routine and infusion stages mentioned by Saga & Zmud (1994). The ISC model is suggested to be useful for understanding use behavior that occurs during the post-acceptance stage. Given that Extended Use is supposed to take place after employees achieve routinized use, it is positioned in the ISC model as the dependent variable for investigation.

For the original TAM and ISC models, it is noted that behavior intention, rather than behavior, is the dependent variable. Nevertheless, under most circumstances, employees in organizations often have no choice but to use the installed system (Brown et al., 2002). Therefore, behavioral intention may not be adequate to explain actual use behavior in the mandatory context (Nah et al., 2004). Emerging literature also suggests that intention to use may not be the best predictor of actual usage in the post-adoptive context (e.g., Jasperson et al., 2005; Kim & Malhotra, 2005). Following this line of reasoning, behavior (i.e., Extended Use) rather than behavioral intention is the focus of this study.

Finally, theories related to technology acceptance have been shown to predict IS usage in situations where an individual can voluntarily exert his/her own choice of behavior; they can be also applied in situations where a user can vary the extent of use, even in mandatory contexts (e.g., Brown et al., 2002; Venkatesh & Davis, 2000; Venkatesh et al., 2003). In this study, given the interest in exploring whether TAM and ISC models are appropriate to explain Extended Use in the mandatory organizational context, a field study was conducted to test the efficacy of these models.

Methods

The purpose of this study is to investigate Extended Use of complex information systems (CIS) within organizational contexts. While CIS is a general concept, ERP systems are typically the target systems in CIS research (e.g., Boudreau, 2003; Ko et al., 2005). An ERP system is conceptually an enterprise-wide IS that incorporates numerous business processes and includes a company's internal and external operations. Thus, ERP systems are the target CIS of this investigation. Meanwhile, Extended Use is suggested to occur after users have routinely used a system. In order to capture Extended Use, the scope of this study was confined within ERP system implementations that have reached the routine stage.

Measurement

All constructs in this study were operationalized with multi-item scales. These measures were adapted from established scales with minor modifications tailored for the ERP context. A seven-point Likert scale was used for every item, with anchors ranging from strongly disagree (1) to strongly agree (7). Appendix A lists the measurement items and sources. Items for Perceived Usefulness (three items) and Perceived Ease of Use (three items) were adapted from Davis (1989). Items for Confirmation of Expectation (three items) and Satisfaction (three items) were adapted from Bhattacherjee (2001). No established measures were available specifically for Extended Use. Nevertheless, the construct Deep Usage (Schwarz, 2003) captures the extent of using more of system features. The original three items of Deep Usage focus on using more system features but do not link usage to support work performance. To ensure the connection between IS usage and work tasks, three items were therefore adapted from the Deep Usage construct for Extended Use, with emphasis on supporting individual task performance. Following the original operationalization by Schwarz (2003), the Extended Use items were controlled within the time frame of a one-month period. This is because Extended Use surpasses routine use and may require users to look for new system features to support their tasks. Unlike routine use, Extended Use may not occur at any time or on a daily basis. Extended Use should therefore be measured against a certain time frame, such as the one-month period.

Data Collection

This study was conducted in a major city in the Pearl River Delta region in south China. The city has more than 400 years of history in international business and is among the cities with highest individual incomes in China (Enright et al., 2005). The data collection consists of three steps. First, questionnaire translation and back-translation between English and Chinese was carried out by certified professional translators (Brislin et al., 1973). Next, a

pilot study was conducted to preliminarily examine construct validity and reliability. Questionnaires for surveys in Chinese were first distributed to 18 employees using ERP in one manufacturing firm. Minor modifications were made, based on the subjects' comments. The revised version of the questionnaire was then administrated to 79 subjects in three other firms, resulting in appropriate convergent validity and reliability.

The official field survey was administered to ERP users in a large manufacturing company in the city. The ERP system used by this company was offered by a premier ERP solution provider with a significant global market share. The firm was chosen for its successful implementation, as recognized by the vendor. Top managers in the firm wanted to coordinate production, inventory management, and sales processes to improve efficiency, drive down costs, and eliminate inconsistencies in accounting processes. The firm used the ERP system to capture and store information and streamline the business processes across the whole organization. Sixteen modules were deployed after the adoption decision. The adopted modules and user interfaces of the ERP system were quite typical in the manufacturing industry. By the time of data collection, the firm had used the ERP system for more than two years. Employees were mandated to use the system. This mandatory context is consistent with most ERP implementation projects in which employee usage is typically compulsory (Nah et al., 2004; Pozzebon, 2002). However, employees were not mandated to use more features to support their activities.

No specific information was available in extant literature on the average time needed to attain routine use of ERP. Nevertheless, empirical evidence suggests that 15 months after implementation, the ERP system installed in an organization was still not being used to its full potential (Boudreau, 2003). In this vein, the two-year implementation span in this study seemed appropriate for capturing Extended Use. Personal visits and telephone calls were made to solicit the CIO's support for this investigation. To ensure the representativeness of

the participants, a random selection process was performed to identify 220 employee ERP users across different departments in the organization. Of the 220 distributed survey questionnaires, 200 were returned. Table 1 presents the demographic characteristics of the survey subjects.

TABLE 1: Sample Demographics

ERP Employee Users	Category	Percentage
Education	Junior High School or lower	1.1%
	Senior High School	23.2%
	College	33.3%
	Bachelor's	40.1%
	Master's	2.3%
Age	18-29 years old	37.3%
	30-39 years old	47.3%
	40-49 years old	14.8%
	50 years old or older	0.6%
Gender	Male	46.2%
	Female	53.8%
Working Department	Finance	15.4%
	Marketing	15.4%
	Production	25.7%
	Human Resource Management	3.4%
	Other, including Sales, Inventory, and Transportation.	40.1%

Data Analysis and Results

Structural Equation Modeling (SEM) was applied for data analysis using AMOS 5.0. The measurement model was assessed before the structural model. This procedure was preformed independently for both the TAM and ISC models.

Measurement Model

The measurement properties of all constructs were first evaluated with Confirmatory Factor Analysis (CFA). For both models, after deleting one item with low loading, the resulting fit indices suggest an acceptable fit (Table 2). Except for the RMSEA of the ISC model, which was close to the recommended 0.08 (Browne & Cudeck, 1993), all indices, particularly the important robust indices of Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI), were above their criterion levels. Meanwhile, Hu & Bentler (1999) proposed a

strict combination rule: (1) SRMR < 0.08, and (2) either CFI > 0.95 or RMSEA < 0.06. Instead of evaluating each index independently, this rule has the advantage of controlling type I and type II errors simultaneously. Results in Table 2 show that indices of both models comply with the combination rule, further supporting the measurement model fit. Descriptive statistics of the constructs are listed in Table 3.

TABLE 2: Goodness of Fit for the Measurement Model

Fit Indices	TAM	ISC	Desired Levels
χ^2/df	1.674	2.306	< 3.0
CFI	0.983	0.969	> 0.90
TLI	0.972	0.955	> 0.90
RMSEA	0.060	0.083	< 0.08
Standardized RMR	0.0382	0.0318	< 0.08
GFI	0.965	0.927	> 0.90
AGFI	0.926	0.873	> 0.80
Number of Latent Variables	3	4	
Total Number of Items	8	11	

TABLE 3: Descriptive Statistics

Construct	Mean	S. D.
Confirmation of Expectation (COE)	5.19	1.23
Satisfaction (SAT)	4.81	1.36
Perceived Usefulness (PU)	5.53	1.05
Perceived Ease of Use (PEOU)	4.92	1.14
Extended Use (Ext_U)	5.11	1.14

Notes: All constructs are seven-point scales with the anchors 1=Strongly Disagree, 4=Neutral, 7=Strongly Agree.

Internal consistency, convergent validity, and discriminant validity were further evaluated by examining the Cronbach's alpha, composite reliability, and average variance extracted (AVE) of each construct (Table 4). Values of Cronbach's alpha and composite reliabilities are all higher than the recommended 0.707 (Nunnally, 1994); and values of AVE are all above 0.50 (Fornell & Larcker, 1981). Next, the value of AVE of every construct is higher than its squared correlations with other constructs (Table 5), supporting discriminant validity (Fornell & Larcker, 1981). The above results collectively suggest that the measurement models are appropriate for TAM and ISC.

TABLE 4: Assessment of Internal Consistency and Convergent Validity

Dimensions	Number of Items	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Confirmation of Expectation	3	0.88	0.93	0.81
Satisfaction	3	0.96	0.97	0.92

Perceived Usefulness	3	0.85	0.91	0.76
Perceived Ease of Use	3	0.80	0.89	0.72
Extended Use	2	0.81	0.91	0.84

TABLE 5: Comparison of AVE and Squared Correlations

Variable	COE	SAT	PU	PEOU	Ext_U
COE	**0.81**				
SAT	0.51	**0.92**			
PU	0.34	0.41	**0.76**		
PEOU	0.42	0.51	0.32	**0.72**	
Ext_U	0.24	0.26	0.23	0.24	**0.84**

Structural Model

The structural models were next evaluated based on the same criteria as for the measurement models. As can be seen in Table 6, the fit indices of both structural models provide evidence of adequate model fit.

TABLE 6: Goodness of Fit for the Structural Model

Fit Indices	**TAM**	**ISC**	**Desired Levels**
χ^2 /df	1.674	2.319	< 3.0
CFI	0.983	0.968	> 0.90
TLI	0.972	0.955	> 0.90
RMSEA	0.060	0.084	< 0.08
Standardized RMR	0.0382	0.0363	< 0.08
GFI	0.965	0.925	> 0.90
AGFI	0.926	0.873	> 0.80
Number of Latent Variables	3	4	
Total Number of Items	8	11	

TAM

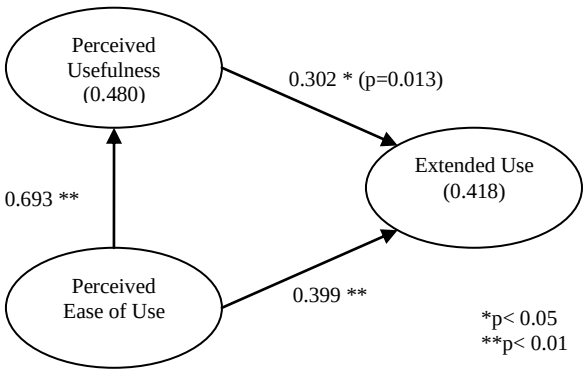

Figure 3 The Results of TAM

As predicted, all relationships suggested by TAM were supported (Figure 3). PU (0.302) and PEOU (0.399) both affected Extended Use; PEOU (0.693) also influenced PU. PEOU and PU jointly explained 41.8% of the variance in Extended Use. Interestingly, PEOU,

as compared to PU, had a much stronger effect on Extended Use. This suggests that individuals' effort expectancy is more important than their performance expectancy when using more features of a technology to support their task performance.

IS Continuance Model

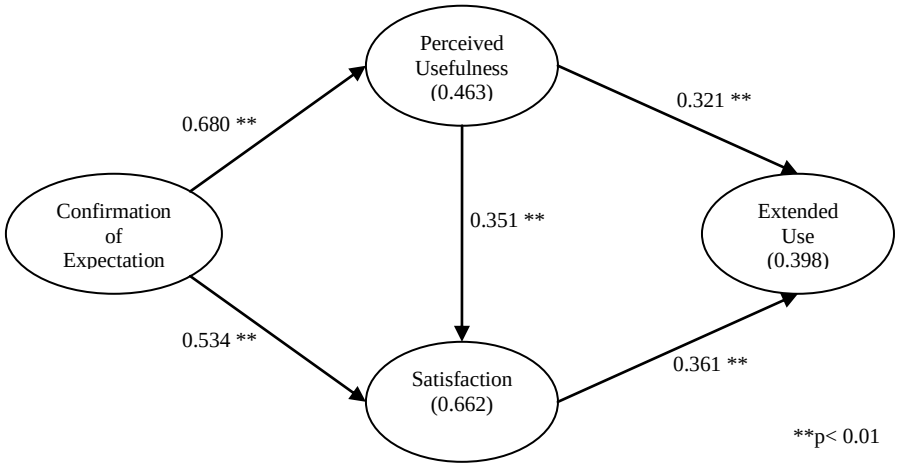

Figure 4 The Results of IS Continuance Model

Consistent with the IS Continuance model, every relationship in the model was significant (Figure 4). Both Satisfaction (0.361) and PU (0.321) impacted Extended Use. Confirmation of Expectation affected Satisfaction (0.534) and PU (0.680). Satisfaction is also affected by PU (0.351). As a whole, the ISC model accounted for 39.8% of the variance in Extended Use, slightly lower than the 41.8% in the case of TAM.

A Post-Hoc Analysis of the Synthesized Model

Although both TAM and ISC successfully explained a significant portion of variance in the dependent variable, the two models revealed some differences in the intelligence. While TAM implies the importance of technology design factors (i.e., PEOU and PU), ISC emphasizes the utility consideration as well as the satisfaction derived from individuals' first-hand experience.

Based on the above results, all factors seemed to play a role in explaining Extended Use. However, in the presence of all these factors, it is uncertain, which one is the most

critical for Extended Use. To address this, a synthesized model (Figure 5) integrating TAM and ISC was proposed post-hoc with the addition of two relationships: (1) from Confirmation of Expectation to PEOU and (2) from PEOU to Satisfaction. Since COE is associated with the confirmation of individual expectations at an earlier stage (Bhattacharjee 2001), and that PEOU and PU are both important expectations toward IS usage (Davis et al., 1989), COE may therefore influence not only PU but also PEOU. Next, it has long been suggested that the quality of an information system, such as PEOU, positively affects user satisfaction (e.g., DeLone & McLean, 1992). Prior research has empirically supported the association between PEOU and Satisfaction (e.g. Rai et al., 2002; Seddon and Kiew, 1994).

The proposed model was next examined with the same dataset. Both the measurement and structural models demonstrated reasonable fit and complied with the evaluation criteria previously mentioned (Table 7). As can be seen in Figure 5, all paths were significantly supported, except the one from Satisfaction to Extended Use. PEOU (0.334) and PU (0.233) affected Extended Use and jointly explained 42.9% of its variance. Similar to the observation in TAM, PEOU exerted a stronger behavioral impact than PU. Surprisingly, contradictory to the result in ISC, Satisfaction had no significant impact on Extended Use.

TABLE 7: Goodness of Fit for the Synthesized Model

Fit Indices	Measurement Model	Structural Model	Desired Levels
χ^2/df	1.990	1.973	< 3.0
CFI	0.966	0.966	> 0.90
TLI	0.954	0.955	> 0.90
RMSEA	0.073	0.072	< 0.08
Standardized RMR	0.0345	0.0354	< 0.08
GFI	0.917	0.916	> 0.90
AGFI	0.886	0.871	> 0.80
Number of Latent Variables	5	5	
Total Number of Items	14	14	

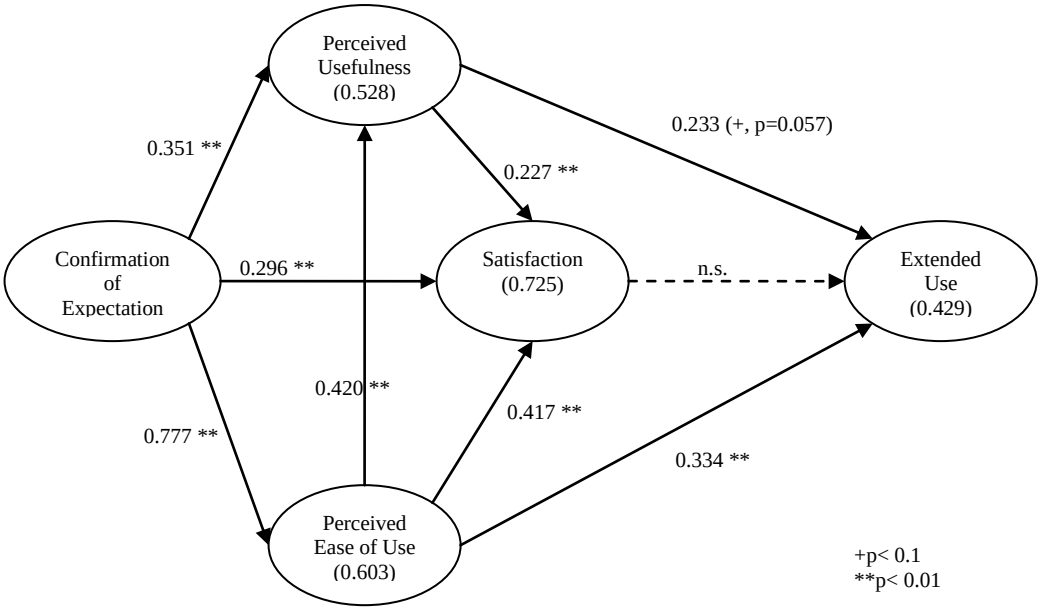

Figure 5 Results of the Synthesized Model

The Comparison of the Three Models

Table 8: Model Comparison

Model	Explained Variance			Path Coefficient		
	Extended Use	Satisfaction	Perceived Usefulness	PU → Ext_U	PEOU→ Ext_U	SAT → Ext_U
TAM	0.418	N.A.	0.480	0.302	0.399	N.A.
ISC	0.398	0.622	0.463	0.321	N.A.	0.361
Synthesized	0.429	0.725	0.528	0.233	0.334	N.S.

N.A.: Not Available N.S.: Not Significant

Table 8 presents the results of the three models. Each model explained approximately 40% of the variance in Extended Use. Although the explained variance is not very high, this result is comparable with the findings of the meta-analysis by Legris et al. (2003) that TAM, even including additional variables, on average explains 40% of the variance in IS usage. A comparison of the three models suggests that the synthesized model explained just slightly more variances in Extended Use, Perceived Usefulness, and Satisfaction than TAM and ISC. On the other hand, the synthesized model provides better information for understanding the behavior of interest. To begin with, the synthesized model permits examination of the influences of PU, PEOU, and Satisfaction simultaneously, thus facilitating a more holistic

point of view. The results reveal the relative importance of the above three factors: PEOU had the strongest influence, PU ranked second, and Satisfaction had none. This ordinal information is especially instrumental in situations where priority is pivotal in determining allocation of limited organizational resources to stimulate Extended Use.

While PU consistently affected Extended Use across all the three models, the results collectively point to the dominant effect of PEOU in explaining Extended Use. This seems to contradict the general perception that PU, relative to PEOU, tends to have a stronger impact on IS usage. A further analysis reviewed prior studies that specifically examined the direct impact of PEOU and PU on actual behavior across various settings. The results in Appendix B suggest that PU, as compared to PEOU, generally has either a similar or stronger influence on use. One exception is the study by Igbaria et al. (1997) where PEOU (beta = 0.31) has a slightly higher impact than PU (beta = 0.29). Such a distinctive result may be attributed to the operationalization of the use construct. Igbaria et al. (1997) applied a multi-dimensional approach and measured not only usage time and frequency but also the number of applications used and tasks supported. Their operationalization captured traditional use as well as, in spirit, Extended Use that concerns using more features for work productivity.

Meanwhile, satisfaction captures users' overall affect on the IS, including their confirmation and post-acceptance beliefs in the usefulness and ease of use of the system. Although Satisfaction significantly influenced Extended Use in the ISC model, it exerted little impact in the synthesized model. The introduction of PEOU seemed to marginalize the effect of satisfaction. This suggests that when individuals consider Extended Use, the importance of PEOU outweighs that of Satisfaction in this context.

What causes PEOU to have such a dominant effect in this study? Using more system features in general demands more cognitive resources. Presumably, when users achieve the routine use mandated by the management, they have met at least the basic level of the

organization's expectations and thus obtained a certain degree of satisfaction. For these users to go the extra mile and use more features to support their performance, the marginal utility and satisfaction gained by using additional features might be secondary to the estimated effort required to cope with the complexity embedded in these features. This apprehension may be even more pronounced in employees who have lower cognitive resources or are fully occupied with other tasks.

The synthesized model also provides information about the antecedents that affect PEOU, PU, and Satisfaction, as well as the relationships among these factors during the post-acceptance stage. Consistent with the expectation confirmation theory, Confirmation of Expectation derived from first-hand experience significantly influenced individual post-acceptance beliefs and Satisfaction. Admittedly, while TAM is structurally most parsimonious, the synthesized model has an edge when it comes to a more comprehensive understanding of Extended Use and the insights for effective managerial interventions.

Limitations

Like most empirical research, this paper has certain limitations. A notable weakness lies in the cross-sectional research design, where all measurement items were collected at the same point of time. Given that the investigated constructs are not supposed to remain unchanged over time, this research method may not fully capture the dynamics of the Extended Use phenomenon. Also, this research employs only one method for data collection and may thus be subject to the common-method bias. The above constraints thereby limit the extent to which causality can be inferred. To address the above issues, future research should consider employing multi-methods and longitudinal research designs. A longitudinal study combining qualitative and quantitative data would enable a process-oriented perspective that cannot be achieved by using a variance-based approach, such as the one employed here.

Another limitation of this research is the self-reported measurement of the Extended Use construct. Straub et al. (1995) have shown the conceptual differences between actual use and self-reported use, as well as the impact of those differences on research findings. For example, PEOU may be related more to self-reported use, as opposed to actual use (Straub et al., 1995). Therefore, caution should be exercised when interpreting the results of this research. Furthermore, it is strongly recommended that research be designed to monitor the actual number of features used, so that researchers may examine the relationships of Extended Use with other factors in the nomological networks discussed.

Furthermore, given the intricacy involved in employees' ERP usage in modern organizations, such factors as the ERP functions applied in different departments, users' ERP experiences, and even the types of industries, may all potentially moderate the revealed findings. While the present study emphasizes the key constructs in TAM and ISC, future research should investigate the possible moderating impact of the related factors.

Contributions and Implications for Research

The present findings have important implications for research and theories. While most extant IS acceptance research focused on the dichotomous adoption decision or initial usage immediately after adoption (Bhattacherjee, 2001), emerging literature is calling for usage behavior that reaches beyond simple and shallow use (e.g. Chin & Marcolin, 2001). This research answers these calls and is one of the few studies focusing specifically on Extended Use. Extended Use, which describes use of more features to support individual task performance, is one advanced use behavior that may occur after employees have attained routine use (Saga & Zmud, 1994). Employees' Extended Use presents an opportunity for organizations to utilize their complex information systems in a more comprehensive and sophisticated fashion.

The nature of Extended Use is theoretically distinct from the often studied use concepts, such as repeated use and regular use. It concerns using a wider range of functionalities for work productivity and is expected to take place during the post-acceptance stage. These notions are not explicitly captured in the traditional use concepts. Researchers should thus pay careful attention to the conceptual distinctions when trying to apply other existing IT acceptance frameworks (e.g., Theory of Reasoned Action, Theory of Planned Behavior, or TAM II) and knowledge (e.g., antecedents of PEOU and PU) to explain Extended Use. Reasonable theoretical arguments should be articulated when connecting the frameworks and Extended Use; the theoretical impact of the conceptual differences should be also explored. For instance, given the significance of PU and PEOU in this paper, it would be valuable to investigate the antecedents of PEOU and PU in the context of Extended Use. Although prior IT acceptance studies have provided valuable knowledge about antecedents of PEOU and PU, their findings also suggested that the salience of these antecedents may vary throughout different implementation stages (e.g., Venkatesh, 2000; Venkatesh & Davis, 2000). Caution should be made when researchers intend to generalize previous knowledge while studying the Extended Use situation.

The theoretical frameworks examined in this research tend to focus on such factors as technology attributes and personal affect. However, beyond technology and individual factors, researchers have argued that organizational, managerial, and social factors can all influence system usage (e.g., Gallivan, 2001). For example, individual tasks in organizations are usually interdependent (Pozzebon, 2002); specialized training to learn the target system can facilitate use (Lippert & Forman, 2005); and peer behavior affects individual use (Gallivan, 2001). The above ideas reveal the untapped organizational complexity that may influence Extended Use, and they warrant future research.

In addition, Benbasat & Zmud (2003) have urged IS researchers to avoid treating the technology artifact as a "black box" and bring the technology for discussion. Indeed, the system of investigation has important implications for Extended Use. The usefulness, the ease of use, the number of available functionalities, and other potential aspects of an information system can have an impact on individual Extended Use. A simple information system can be easy to use and useful, but it may not necessarily provide a full range of functionalities that can support organizational processes. On the other hand, complex information systems like ERP are very sophisticated (Gattiker & Goodhue, 2005) and represent a completely different class of IT application. The complexity and malleability of complex information systems permits employees to use the systems at different levels of sophistication (Moore, 2002). Although the research model in this study may be applicable to both simple and complex information systems, different classes of IT applications may vary substantially in their potential for Extended Use. Studies of Extended Use should, therefore, pay attention to the technology of investigation and examine its potential behavioral consequences.

Meanwhile, this research takes place in an organizational setting where regular usage is enforced. Within this mandatory context there is a higher possibility that users will develop familiarity with the system. Such familiarity gives users a foundation to explore more features, as they are better prepared to evaluate unused functionalities. Conversely, in a voluntary setting where individuals control their own behavior, those users who rarely use the system may have less knowledge to appropriate the system to a higher level. Although the investigated context of this research permits little insight into Extended Use in voluntary settings, the findings are still of significant practical value because employee usage of complex information systems is usually obligatory in organizations. Nevertheless, more research of Extended Use in various settings is needed to better understand the contingency effect of voluntariness and mandatoriness.

Moreover, in the mandatory setting, employees may be compelled to use a system before they mentally accept the technology. In this case, employees' attitude and mental acceptance have no bearing on their decision to use the system. They may need to use a system that they mentally reject. The notion "innovation dissonance" (Karahanna, 1999; Rawstorne et al., 1998) refers to a situation in which mental acceptance is in conflict with actual behavior. Understandably, such internal tension as innovation dissonance can hardly lead to a higher level of use like Extended Use. Interested researchers may study individuals' mental acceptance of the target technology and its impact on individual usage, particularly in the mandatory context.

Implications for Practice

The salience of Perceived Usefulness suggests that employees are outcome-oriented in the organizational context. Although usage may be compulsory, employees still have the discretion about the level of use, or how to use the system, to support their tasks (Silver, 1991). Their motivation to use the technology beyond the regular level is contingent upon the utility of the system. More importantly, managers should be aware that the most important consideration is the employees' estimation of the required effort to deal with the complexity involved in using more features. For employees' Extended Use, this concern outweighs utility expectancy. For best results, managers should emphasize the user-friendly aspect of the technology, thereby lowering employees' psychological burden so they can be more ready to engage in Extended Use.

In addition, although Satisfaction is not directly associated with Extended Use in the synthesized model, empirical findings have revealed its behavioral impact on individuals' continuance intention (Bhattacherjee, 2001). As continued use is a critical measurement of system success, and Satisfaction strongly influences individual continuance intention (Bhattacherjee, 2001), the insignificance of the relationship between Satisfaction and

Extended Use by no means implies that user satisfaction is not important for IS implementation. Instead, managers should be aware of the affects that Satisfaction has on different types of use behavior. Such insights empower managers to devise more delicate interventions for the desired outcomes.

Finally, Confirmation of Expectation is a pivotal connector that channels individual experience from previous stages into present personal beliefs and affects, eventually having an impact on individual behavior. This suggests that employees' interaction with the target system is imperative for their ensuing usage behavior. Their direct experience at earlier stages can either intensify or weaken their subsequent usage (Hartwick & Barki, 1994; Kay & Thomas, 1995). Toward this end, the notion of "Experience Economy" (Pine & Gilmore, 1999) sheds light on the value of experience management in IS implementation. In the experience economy, processes that allow individuals to generate more positive experiences are of higher value. In this vein, the value of contemporary organizations lies in their ability to foster favorable experiences. Similarly, being able to cultivate positive user experience in every stage of the system implementation process will directly or indirectly facilitate a higher level of system usage that leads to organizational success.

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Appendix A Construct Measurement

Construct	Measure	Sources
Perceived Usefulness	PU1. Using the ERP system improves my job performance. PU2. Using the ERP system in my job increases my productivity. PU3. Using the ERP system enhances my effectiveness in my job.	Davis (1989)
Perceived Ease of Use	PEOU1. It will be easy to get the ERP system to do what I want it to do. PEOU2. My interaction with the ERP system would be clear and understandable. PEOU3. I would find the ERP system to be flexible to interact with.	Davis (1989)
Confirmation of Expectation	COE1. My experience with using the ERP system was better than what I expected. COE2. The service level provided by the ERP system was better than what I expected. COE3. Overall, most of my expectations from using the ERP system were confirmed.	Bhattacherjee (2001)
Satisfaction	SAT1. I am very satisfied with the ERP system usage. SAT2. I am very pleased with the ERP system usage. SAT3. I am very content with the ERP system usage.	Bhattacherjee (2001)
Extended Use	EXU1. In a typical one-month period, I often use most of the features of the ERP system installed in my organization to support my work. EXU2. In a typical one-month period, I often use more features than the average user of the ERP system installed in my organization to support my work. EXU3. In a typical one-month period, I often use more obscure aspects of the ERP system installed in my organization to support my work. (Dropped)	Schwarz (2003)

Appendix B: A Review of Studies with Direct Impact from PU and PEOU to IS Use

Study	Technology	Subject	Voluntary or Mandatory	Use Stage	Findings
Davis (1989)	PROFS electronic mail, XEDIT file editor, two IBM PC-based graphics systems (Chart-Master and Pen-draw)	Study 1: 120 IBM employees Study 2: 40 MBA students	Not mentioned	**Study 1:** Average of six month's experience **Study 2**: Unfamiliar with the two systems used in the study, but given one hour of hands-on demonstration	1. Study 1: Beta (PU → current B)= 0.57 Beta (PEOU → current B) non-significant 2. Study 2: Beta (PU → future B) = 0.75 Beta (PEOU → future B) non- significant
Keil et al. (1995)	CONFIG (an expert support system)	177 and 129 company sales representatives	Voluntary	From the old version CONFIG to the new version CONFIG	1. For old CONFIG, Beta (PU → B)= 0.42 PEOU → B non-significant 2. For new CONFIG Beta (PU → B)= 0.43 PEOU → B non-significant
Igbaria et al. (1997)	Personal computer	358 users in small firms	Not mentioned	Not specified	Beta (PU → B) = 0.29 Beta (PEOU → B) = 0.31
Gefen & Keil (1998)	CONFIG (an expert system)	196 sales representatives or sales support personnel	Not mentioned	Four months after its deployment	Beta (PU → B) = 0.70 Beta (PEOU → B) non-significant
Agarwal & Prasad (1997)	World Wide Web (WWW)	73 MBA students	Voluntary	Not Specified	1. Beta (Relative advantage → current B) non-significant Beta (PEOU → current B) non-significant 2. Beta (Relative advantage → Future BI) = 0.49 Beta (PEOU → Future BI) non-significant
Lucas & Spitler (1999)	Workstation	49 brokers and 58 sales assistants at a major investment bank	Not specified	Within one year	1. Beta (PU → current B) non-significant Beta (PEOU → current B) non-significant 2. Beta (PU → Intended Use) non-significant Beta (PEOU → Intended Use) non-significant

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