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Innovate with Complex Information Technologies: A Theoretical Model and Empirical Examination

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INNOVATE WITH COMPLEX INFORMATION TECHNOLOGIES: A THEORETICAL MODEL AND EMPIRICAL EXAMINATION

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ABSTRACT

Complex information technologies (CITs), such as ERP packages, have become the core component of modern organizations. Corporate investments in CITs have soared to a record high. Firms need to creatively apply the technologies in order to adapt to the ever-changing environments and realize the full potential of the technologies. We approach this issue from the perspective of '*Innovate with IT'*, a post-acceptance usage behavior that describes innovative use of information technologies to support individual task performances. Drawing upon the IS Continuance (ISC) model, as well as the managerial and individual factors that facilitate higher level IT use, a model is theoretically developed to understand employees' novel use of CITs. A field study was conducted in a large manufacturing firm using ERP packages to empirically validate the model. The results suggest that the ISC model, personal propensity toward IT innovations, and management support jointly nurture employees' creative use of complex technologies.

Keywords: Post-acceptance Use, Innovate with IT, Complex Information Technologies

INTRODUCTION

Modern organizations are increasingly depending on information technologies (ITs) to gain and sustain their competitive advantages. Their investments in new ITs have increased rapidly in recent years. For instance, organizations worldwide spent $20 billion on implementation of enterprise resource planning (ERP) packages in 2000 [56]. Such investments increased to $26.7 billion in 2004, and are expected to rise to $37 billion by 2008 [30]. It is quite common for large organizations to spend more than $100 million on ERP projects [50]. Implementing complex information technologies (CITs) such as ERP [9] represents strategic and risky decisions that require tremendous organizational resources. Unfortunately, firms that implement ERP seldom use the technologies to the fullest potential, to realize the promised return on investment [29]. Furthermore, in the face of fierce competition, firms that can stimulate employees to apply ITs creatively are more likely to successfully respond to the ever-changing market situations [5, 11]. But how can managers effectively nurture employees' innovative use of CITs? Towards this end, this research turns to the concept of '*Innovate with IT'* (IwIT), or a higher level usage behavior that is innovative in nature and can potentially lead to better results and returns.

The complex and yet malleable CITs allow users to apply the technologies at different levels of sophistication [38]. In organizational contexts, although employees are usually required to use implemented CITs, they still have the discretion to decide the extent of their usage and effort. They can use CITs either narrowly or broadly, in ways that expand the utilities and capacities of the technologies [13]; and either shallowly or deeply [14], in ways that go beyond the requirements of tasks prescribed by the managers. Novel IT usage can stimulate high productivity, generate higher value-addition in goods and services, and ultimately enhance organizations' ability to compete in the knowledge-driven economy [5]. As employees' innovation with IT is believed to help realize the full potential of ITs [4], leading enterprises like Nike, Intel, 3M, or Microsoft have all strongly encouraged employees' IT-based innovation [12].

As higher level use usually takes place after uses' initial usage, or *acceptance* [5, 48], IwIT can be viewed as post-acceptance behavior that involves creative use of a technology to support one's tasks. This shift towards examining IwIT implies that extant adoption and acceptance models (e.g. Technology Acceptance Model) need to be revisited. Key factors that influence an individual's attempts to innovatively use CITs may differ from those responsible for dichotomous adoption decisions and initial usage. In this vein, drawing from the IS Continuance (ISC) model, and the facilitating factors for IT innovations (i.e. management support, personal IT Innovativeness (PIIT), and computer self-efficacy (CSE)), we propose a research model for understanding employees' innovative use of complex information technologies. The model was examined empirically, utilizing data from a field survey of employees using ERP technologies in a large manufacturing organization.

While the majority of extant technology acceptance research focuses on shallow usage, covering only the simple measures of whether an IT is used and the extent of its usage [14], limited theoretical explanations are available for 'Innovate with IT'. This paper is one of the few early studies that investigate usage behavior that goes beyond simple, shallow, and routine use and represents an important step towards understanding exactly what it takes to foster innovate use of CITs.

THEORETICAL FOUNDATIONS AND RESEARCH HYPOTHESES

Innovate with IT

Based on the theory of trying, Ahuja and Thatcher [5] have proposed the concept of 'Trying to Innovate with IT' as a *predictor* of individuals' novel use of IT. They defined 'Trying to Innovate with IT' as a user's goal of finding new uses of existing workplace information technologies. In addition, it is suggested that creative IT usage behavior is more likely to take place long after users' initial usage and acceptance decisions [48]. Ahuja and Thatcher thus contended that 'Trying to Innovate with IT' will occur during the post-acceptance stage. Meanwhile, some researchers have recently recommended investigating actual behavior instead of the proxies, such as behavioral intention or goal, in the post-acceptance context [29, 31]; a proxy may not guarantee the occurrence of behavior because of other impediments [5] or because of the mandatory contexts [39]. In light of the above discussions, this study focuses on individuals' actual behavior, or '*Innovate with IT'*， rather than goal, or 'Trying to Innovate with IT', as the focal dependent variable. Moreover, it is important to ensure that employees' innovation enhances their work performance, instead of resulting in other unintended consequences. Therefore, 'Innovate with IT' is defined as new uses of existing workplace information technologies by an individual to support his/her task performance.

As discussed earlier, IwIT is more likely to occur at the post-acceptance stage and is critical to IT effectiveness [48]. To attain IwIT, it is necessary for users to achieve continued usage, and then to explore and find ways of creatively using the technology. In this vein, we propose a research model that synthesizes the **IS continuance model** and the **facilitating factors of higher level IS use**. While the IS continuance model taps into the aspect of sustained usage, the facilitating factors framework captures factors that can drive novel use of complex information technologies.

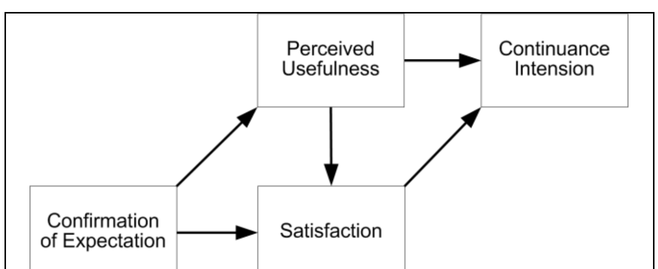

Figure 1. The IS Continuance Model

From the individual perspective, Bhattacherjee developed the IS continuance (ISC) model (Figure 1) [7], which is suited for explaining post-acceptance behavior. ISC posits that a user's continuance intention is determined by his or her perceived usefulness (PU) and satisfaction (SAT) with previous usage. SAT, in turn, is influenced by perceived usefulness and confirmation of expectation (COE), following actual use. In addition, positive COE affects PU. Since 'Innovate with IT' is supposed to occur during the post-acceptance stage [5, 48] and includes the element of continued use, the IS continuance model serves as an ideal theoretical foundation. We thus employ IwIT, instead of continuance intention, as the dependent variable.

In organizational contexts, employees' IT usage can be affected by both organizational and individual factors [5, 23, 29]. For instance, Gallivan has suggested that managerial intervention, as well as individual traits, influence employees' IT usage [23]. As organizational CITs are usually complicated and interdependent [9, 45], specialized training, resources support, and expectations of the management are important to employees' successful IT innovative behaviors [23, 26, 34]. Management support (MS) is, therefore, included in the research model to reflect these organizational dynamics. Also, individual related factors are suggested to exert the most immediate influences on individual cognitive interpretations of, and response to, IT innovations [23, 33]. Among the individual related factors, computer self-efficacy (CSE) and Personal IT Innovativeness (PIIT) are the two constructs that have received consistent support as important predictors of cognitive beliefs and usage behavior [e.g. 1, 16]. In this vein, we incorporate Computer self-efficacy (CSE) and Personal IT Innovativeness (PIIT) as individual internal capacity facilitating IT-based innovative behaviors.

Research Model and Hypotheses

The research model (Figure 2) rests on the synthesis of 'Innovate with IT', the post-acceptance model of IS continuance, and organizational and personal facilitating factors for innovative IT usage. The IS continuance model suggests that post-acceptance behavior is influenced by affective considerations and perceived usefulness. The facilitating factors, on the other hand, propose that employees' novel use of IT is influenced by managerial interventions and personal factors from employees themselves. These important factors aid the development of the following research hypotheses.

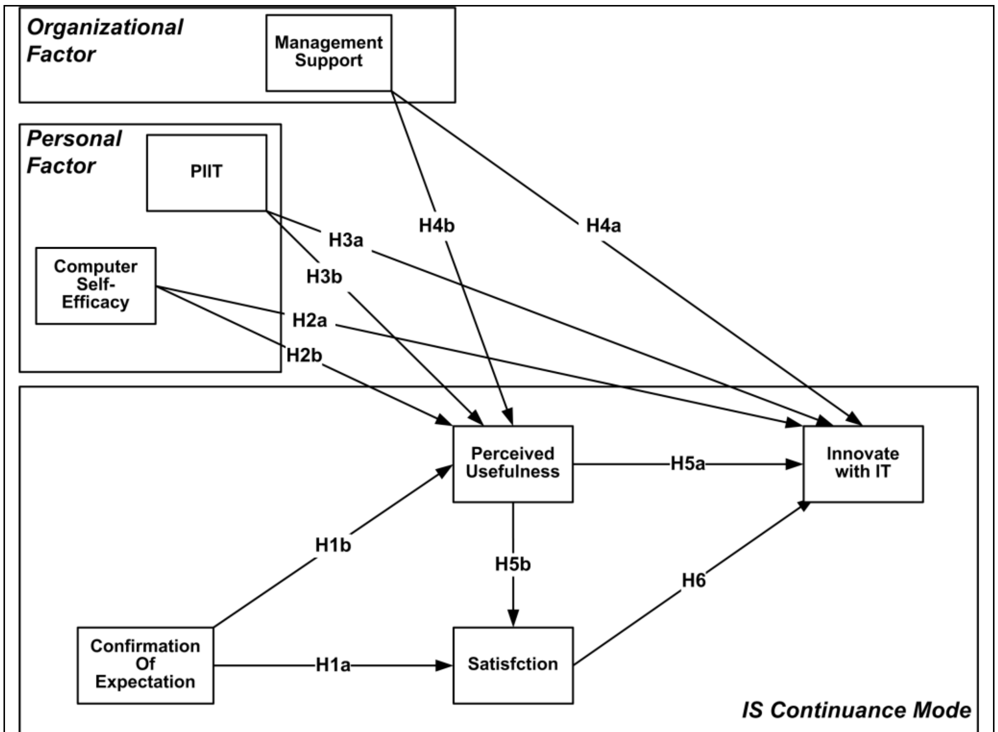

Figure 2. Research Model

According to the ISC model, confirmation of expectation (COE) and perceived usefulness (PU) are two important cognitive beliefs during the post-acceptance stage. Confirmation is the extent to which expectation is fulfilled [7]. Conversely, disconfirmation occurs when actual performance is lower than the expected performance [52]. Confirmation is positively related to satisfaction (SAT) with IS use because it implies realization of the expected benefits of IS use.

H1a. Confirmation of Expectation has a positive effect on Satisfaction.

COE can also affect PU at the post-acceptance stage [7]. During the acceptance stage, since users have little information about the new technology, they are less sure about what to expect from technology use. Therefore, they may have less stable usefulness perceptions of the technology [7]. These initial usefulness perceptions can bee easily confirmed after direct interaction. Such perceptions may be more realistic as users become more knowledgeable about and familiar with the IT. Nonetheless, users may experience cognitive dissonance or psychological tension if their actual usage does not produce the results they expected. Users often have the tendency to adjust their perceptions in tune with actual results. In other words, confirmation can elevate perceived usefulness.

H1b. Confirmation of Expectation has a positive effect on Perceived Usefulness.

IS researchers have contended that individual-related factors affect cognitive evaluation and use of ITs [23, 33]. Among these factors, computer self-efficacy (CSE) and personal innovativeness with IT (PIIT) have received consistent support as important predictors. Conceptually speaking, CSE and PIIT represent the internal capital or capacity that one can deploy for innovatively using IT.

Computer self-efficacy is defined as the belief in one's ability to use an information technology [15, 16]. The inclusion of CSE is pivotal to the recognition that IT implementation is not just about convincing people of the benefits to be derived from using ITs, but also about ensuring the requisite skills and confidence. Newly introduced organizational ITs are often based on complex technologies that impose a high knowledge burden and are difficult for end users to grasp [25]. In such cases, end users' confidence in their ability to learn and use CITs may be critical to their innovative use of these technologies. Furthermore, Compeau and Higgins [15] argued that computer self-efficacy influences outcome expectation, such as perceived usefulness, suggesting that individuals with higher confidence levels may be more capable of appreciating the benefits of IT usage. Based on the above discussion, we propose the following hypotheses:

H2a. Computer self-efficacy has a positive effect on 'Innovate with IT'.

H2b. Computer self-efficacy has a positive effect on Perceived Usefulness.

Personal innovativeness with IT (PIIT) denotes the degree to which an individual is willing to try out any new IT [1]. It is treated as an individual's propensity, associated with more positive beliefs, about technology use. Earlier diffusion research has described individuals as innovative if they are early to adopt an innovation [47]. Thus, people with higher PIIT are supposed to be more innovative in the domain of information technologies [33]. It is suggested that individuals with higher PIIT may develop more positive perceptions about IT innovations [1]. In addition, PIIT could potentially affect how individuals respond to IT innovations [1]. PIIT characterizes the risk-taking propensity that exists in innovators. Rogers [47] suggested that innovators are able and willing to cope with higher levels of uncertainty. They may have the tendency to explore more new ways of using IT, rather than relying on standardized routines. As a result, individuals who are more innovative toward IT may be more likely to creatively use complex ITs to enhance their job performance.

Personal innovativeness with IT helps us to further understand the mechanism that forms perceptions and the role that individual disposition plays in the implementation process [1]. Innovators are more likely to embrace IT innovations, explore the technologies, and appreciate the usefulness of the technologies, than those who are less innovative.

H3a. Personal Innovativeness with IT has a positive effect on 'Innovate with IT'.

H3b. Personal Innovativeness with IT has a positive effect on Perceived Usefulness.

Management support refers to the ways in which organizations encourage IT usage and the degree to which they provide necessary resources to facilitate IT implementation. Management support includes encouragement, expectation, and such activities as allocating resources, offering training, and providing expert support when needed [23, 26]. These activities bear important implications for employees’ acceptance and application of ITs, as substantial resources are required for successful IT implementation [7]. During this process, managers need to work closely with end users to negotiate, persuade, motivate, and support employees’ usage. Management support is also crucial for changing existing routines and processes in order to achieve the fullest potential of ITs [46]. In this context, the encouragement, resources, support, and training offered by the management fertilize employees' usage and stimulate employees to apply technologies in novel ways. The above discussions suggest that management support serves as an important facilitating condition for employees to innovate with complex ITs. We, therefore, expect that:

H4a. Management Support has a positive effect on ‘Innovate with IT’.

Meanwhile, perceived usefulness also plays an important role throughout IT implementation processes [7, 18]. Managerial interventions, such as user training and technical support, are instrumental in helping employees understand the technologies and ensuring realistic expectations from implementation success [18, 28, 36]. High levels of training and technical support can promote favorable beliefs about the technology among employees [27, 35]. Moreover, management support reflects the formal stance of an organization toward IS usage, providing clues about the plausible consequences of using the technology. Such a signal may thereby foster positive outcome evaluations.

H4b. Management Support has a positive effect on Perceived Usefulness.

Previous studies have also revealed that perceived usefulness impacts individuals' affects substantively across innovation stages [7, 18]. While attitude and satisfaction both represent individual affects, satisfaction can be conceived as a post-acceptance affect [7]. Moreover, as perceived usefulness influences attitude affect during acceptance, perceived usefulness is expected to be the salient ex post expectation that influences satisfaction affect at the post acceptance stage [7].

H5a. Perceived Usefulness has a positive effect on Satisfaction.

Perceived usefulness motivates individual usage behavior because of its instrumental consideration. Perceived usefulness at the acceptance stage is typically based on others' opinions or information disseminated through the mass media or social networks [7]. On the other hand, at the post-acceptance stage, perceived usefulness is formed mostly through users' own first-hand experience and is, therefore, more reliable [7]. For employees to find new ways of using complex ITs to support their task performance, or 'Innovate with IT', their evaluation of the utility of technology use represents the logical and rationale assessment, i.e. whether their time and effort is paying off. In this vein, the higher the perception of usefulness of the complex IT, the more likely they will innovate with the technology.

H5b. Perceived Usefulness has a positive effect on 'Innovate with IT'.

Satisfaction is an experience-based affect reflecting users' overall feeling about their interaction with a technology [7, 41] . IS literature has also consistently supported the strong association between user satisfaction and usage behavior [7, 19, 20, 49]. For employees to innovate with a complex IT, their satisfaction serves as an affective precondition of their innovative behaviors. If employees are satisfied with their direct use of the technology, they are more likely to embrace it, continue their usage, and even use it creatively. On the other hand, if employees do not affectively accept the technology, although they are required to use the complex ITs, they are less likely to innovate. This leads to the following hypothesis:

H6. Satisfaction has a positive effect on 'Innovate with IT'.

Control Variable

Prior studies have reported that individual responses to IT may vary across personal factors such as gender, education, and age [2, 54, 55]. In addition, employees' CIT use may be contingent upon the functional departments in which they work. These factors are, therefore, controlled in this study.

RESEARCH METHODOLOGY

To empirically test the research model and hypotheses, a cross-sectional field study was conducted in a large manufacturing firm that implemented complex information technologies. To test the research hypotheses, we used a survey method for data collection. This section describes the construct operationalization, the survey sample, and the data collection procedure.

Measures

The research model has seven constructs, all of which were operationalized using multi-item scales. These measures were adapted from established scales in prior research. Appendix A lists the specific items and their sources. Three items for Perceived Usefulness were adapted from Davis [17]. Three items for Confirmation of Expectation and three items for Satisfaction were adapted from Bhattacherjee [7]. Personal innovativeness with IT was measured using the four original items from Agarwal and Prasad [1]. Following Gallivan et al. [24] and Taylor and Todd [53], a portion (three) of the ten items developed for computer self-efficacy by Compeau and Higgins [16] were adapted, in order to control the length of the instrument. Similarly, we adapted four of the eight items used by Igbaria [26] for management support. For 'Innovate with

IT', which is defined as finding new uses of existing workplace information technologies to support task performance, we adapted the original two items for 'Trying to Innovate with IT' [5] by focusing on the actual innovative usage behavior, with emphasis on supporting the task performance. While most items were operationalized with seven point Likert scales, items for CSE were measured with eleven point scales, as was done by Compeau and Higgins [16].

Data Collection

The study aims to investigate employees' Innovation with Complex ITs (CITs) in the organizational contexts. ERP packages are typically the target technologies in CITs research [8, 9, 32]. ERP technologies are conceptually enterprise-wide technologies that incorporate numerous business processes and include a company's internal and external operations [9]. The complexity of ERP technologies suggests that knowledge learned in simple technology implementation environments may not be readily applicable to the ERP contexts [6]. Unlike traditional and simple information technologies, ERP technologies are highly sophisticated and represent a completely different class of IT applications. ERP technologies are, therefore, the target CITs of this investigation.

Meanwhile, higher level usage behaviors like 'Innovate with IT' are more likely to occur after users have accepted and routinely used an IT [5, 48]. In order to capture this phenomenon, the scope of this study was confined to ERP implementations that have reached the stage of routine. The unit of analysis is individual end-users of an ERP technology within organizations.

The empirical study was conducted in the Guangzhou city in south China. With more than 400 years experience in international business, the city has one of the highest per capita incomes in China [21]. The city is also the capital of the Guangdong province, GDP of which exceeded the GDPs of Singapore and Hong Kong in 2006[1]. The data collection involved three steps. First, two certified translators performed the standard instrument translation and back-translation between English and Chinese [10]. A pilot study was next conducted to examine construct validity and reliability by administrating questionnaires to eighteen employees of a company using ERP in one company. Minor revisions were made according to the subjects' feedbacks. The revised questionnaires were further distributed to seventy-nine subjects in three other companies, resulting in acceptable construct validity.

The questionnaire was officially administered to knowledge workers, who use ERP, in a large manufacturing firm in the city. The ERP packages deployed came from an internationally top-ranked ERP vendor. The firm was chosen for its successful implementation, as affirmed by the vendor. By the time of data collection, the firm had installed sixteen modules that were typically designed for the manufacturing industry, and had used the ERP packages for more than two years.

Like most ERP projects, employees in the company were mandated to use the system [39, 45]. However, employees were not mandated to find new ways of applying the technology. Our in-depth interview with firm managers confirmed that, unlike front-line workers who would only routinely use ERP for simple input and output applications, the targeted knowledge workers had the discretion for modifying current applications and suggesting new uses of the ERP packages.

While no prior literature offer specific timeline for organizations attaining routine use of ERP, suggestive evidences showed that the ERP technologies have not been applied to their full potential fifteen month after implementation [8]. In this vein, the two-year implementation span in this study seemed appropriate for capturing 'Innovate with IT'. With the full support of the CEO, survey instruments were distributed to two hundred and twenty subjects, randomly

[1] http://www.newsgd.com/ news/guangdong1/200601280008.htm

selected across different departments. Two hundred of them returned the questionnaires. Table 1 displays the demographics of the responding subjects.

DATA ANALYSIS & RESULTS

TABLE 1: Sample Demographics

Dimension	Category	Percentag
Education	Junior High 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%
Department	Finance	15.4%
	Marketing	15.4%
	Production	25.7%
	Human Resources	3.4%
	Others	40%

Measurement Model

Structural Equation Modeling (SEM) was applied for data analysis, using AMOS 5.0. The measurement model was evaluated prior to the structural model, in terms of reliability, uni-dimensionality, convergent validity, and discriminant validity. After dropping one item of low loading, the measurement model achieved acceptable fit (Table 2). Table 3 shows the descriptive statistics, correlations, reliabilities, and average variance extracted (AVE).

For internal consistency, the values of Cronbach's alpha and composite reliabilities (Table 3) were all greater than 0.707 [40]. In addition, the AVE for each construct was higher than 0.50, suggesting that observed items explain more variance than the error terms [22]. Unidimensionality was also supported by AVE higher than 0.50 and composite reliabilities higher than 0.70 [51]. Next, discriminant validity is supported if AVE of a construct is higher than its squared correlations with other constructs [22]. Results in Table 3 suggest good discriminant validity.

TABLE 2: Fit Indices

Fit Indices	Measurement Model	Structural Model	Desired Levels
χ^2/df	1.927	1.829	$<$ 3.0
CFI	0.94	0.93	$>$ 0.90
TLI	0.93	0.91	$>$ 0.90
RMSEA	0.07	0.066	0.05-0.08
Standardized RMR	0.056	0.054	$<$ 0.08

TABLE 3: Descriptive, Internal Consistency, Convergent and Discriminant Validity

Constructs (a)	Mean	S.D.	PIIT	CSE	MS	COE	SAT	PU	IwIT
PIIT (3)	4.96	1.14	**0.54** (c)						
CSE (3)	7.37	1.65	0.12	**0.72**					
MS (4)	5.91	0.90	0.03	0.12	**0.52**				
COE (3)	5.19	1.23	0.03	0.04	0.22	**0.71**			
SAT (3)	4.81	1.36	0.04	0.02	0.17	0.51	**0.76**		
PU (3)	5.45	1.10	0.07	0.02	0.17	0.34	0.41	**0.62**	
IwIT (2)	4.69	1.26	0.19	0.01	0.05	0.16	0.15	0.19	**0.69**
Cronbach's α			0.74	0.88	0.81	0.89	0.9	0.83	0.82
Composite Reliability			0.78	0.88	0.81	0.88	0.91	0.83	0.82

a. Number of Measurement Items
b. PIIT=Personal Innovativeness with IT; MS=Management Support; CSE=Computer Self-efficacy; COE=Confirmation of Expectation; SAT=Satisfaction; PU=Perceived Usefulness; IwIT=Innovate with IT
c. Diagonals represent the value of average variance extracted (AVE).
d. Off diagonal elements are the squared correlations among constructs.
e. For discriminant validity, diagonal elements should be larger than off-diagonal elements.
f. Items of all constructs, except CSE, are on seven-point scales with the anchors 1=Strongly Disagree, 4=Neutral, 7=Strongly Agree. Items of CSE use an eleven-point scale with anchors 0 = Not at all Confident, 10 Totally Confident

Structural Model

Following the establishment of the measurement model, we proceeded to examine the structural model fit. Fit indices in Table 2 collectively suggest a good fit between the structural model and data. Figure 3 illustrates the resulting path coefficients and explained variances.

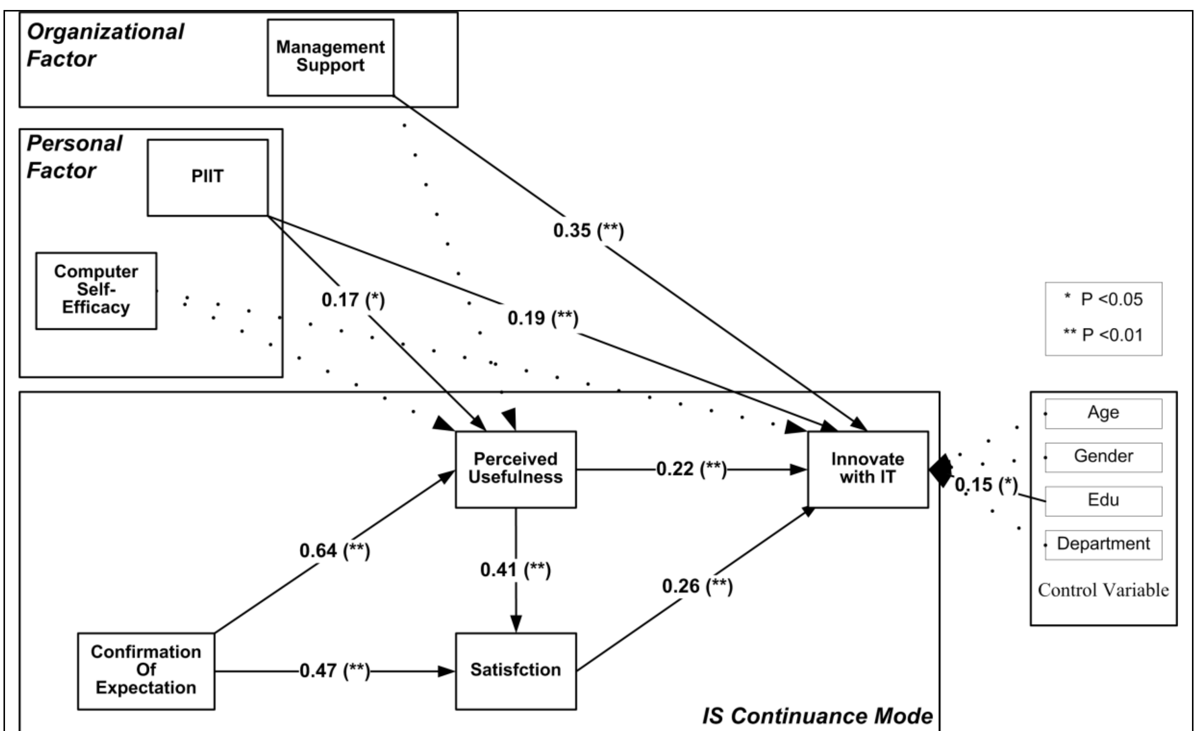

Figure 3. Structural Model

As can be seen in Figure 3, the model successfully explained 61% of the variance in 'Innovate with IT'. 'Innovate with IT' was predicted by Satisfaction (β=0.26), Perceived Usefulness (β=0.22), Personal Innovativeness with IT (β=0.19), and Management Support (β=0.35). In addition to the direct effect, Perceived Usefulness also indirectly influenced 'Innovate with IT' (β=0.11)[2] via user satisfaction. Personal Innovativeness with IT, too, had an indirect effect on 'Innovate with IT' (β=0.04) via Perceived Usefulness. Meanwhile, Perceived Usefulness was affected by Confirmation of Expectation (β=0.64) and PIIT (β=0.14). These two factors jointly accounted for 57% of the variance in Perceived Usefulness. Satisfaction was affected by Confirmation of Expectation (β=0.47) and Perceived Usefulness (β=0.41), which collectively explained 67% of the variance in Satisfaction. Confirmation of Expectation also indirectly influenced Satisfaction (β=0.26) via Perceived Usefulness. Education, one of the control variables, also had a positive effect on 'Innovate with IT'. This is consistent with findings in prior literature that one's educational attainment can benefit personal innovation [2, 47].

On the other hand, Computer Self-efficacy had no behavioral impact on either PU or 'Innovate with IT', thus rejecting H2a and H2b. Although Management Support affected 'Innovate with IT', it did not influence Perceived Usefulness as expected; H4b is also rejected.

DISCUSSIONS

Table 4 summarizes the findings. In total, eight of the eleven hypotheses were supported. As all the hypotheses embedded in the ISC model were supported, the ISC model appears to be a useful framework for understanding post-acceptance usage behaviors, including 'Innovate with IT'. In line with our expectations, employees' Innovative use of complex ITs is also determined

[2] If an antecedent (e.g. Perceive Usefulness) influenced IwIT through a mediating factor (Satisfaction), its overall impact on IwIT was calculated as the cross-product of its impact on the mediator ($\beta_{(\text{Perceived Usefulness} \rightarrow \text{Satisfaction})}$) and the impact of the mediator on IwIT ($\beta_{(\text{Satisfaction} \rightarrow \text{IwIT})}$).

by their risk-taking propensity in IT (i.e. PIIT) and managerial interventions that provide encouragement, resources, support, and training for technology implementation.

TABLE 4: Summary of Findings

MODEL/FACTORS			HYPOTHESES	RESULT	FINDINGS
IS Continuance Model			H1a, H1b, H5a, H5b, H6	ALL (√)	ISC is applicable for explaining IwIT.
Facilitating Conditions	Individual Factors	*Computer Self-Efficacy*	H2a (direct effect) H2b (indirect effect via PU)	H2a (X) H2b (X)	CSE has no effect on IwIT.
		Persona IT Innovativeness	H3a (direct effect) H3b (indirect effect via PU)	H3a (√) H3b (√)	PIIT has both direct and indirect effect on IwIT.
	Managerial Interventions	*Management Support*	H4a (direct effect) H4b (indirect effect via PU)	H4a (√) H4b (X)	Management Support only has direct effect on IwIT.

The relationship between PU and IwIT implies the critical role of employees' tendency to take a tool-oriented view of CITs in organizations. Employees are more likely to creatively use CITs when they think the technologies can provide considerable or desirable outcomes. Perceived Usefulness, in turn, was influenced by both users' Confirmation of Expectation and their Personal Innovativeness with IT. The importance of Confirmation of Expectation to Perceived Usefulness suggests that users' perception of the technology's usefulness would be adjusted to the extent of confirmation [7].

Among the individual characteristics, as expected, Personal Innovativeness with IT exhibited a strong effect on Perceived Usefulness and 'Innovate with IT', whereas Computer Self-efficacy had none. Implementing CITs, such as ERP packages, is a risk-taking behavior [25]. Our results strongly support the view that users' risk-propensity has very positive influences on their innovative use of CITs. Individuals with higher PIIT can better appreciate CITs and engage in new ways of using these technologies.

Contrary to the previously detected positive relationship between CSE and PU [15], CSE did not impact PU in this research. The answer to such an inconsistency may lie in the context of investigation. As the ERP technology had been implemented in the firm for more than two years and the users had been using the technology for a long time, the employees were supposed to be quite confident about their ability to use the technology. A speculative explanation is that the influence of CSE on PU may attenuate as users gain more direct experience. During the acceptance stage, novice users' outcome expectations can be very sensitive to their perception of their own abilities. As users accumulate additional knowledge and experience about the technology and form more realistic expectations about what the technology can deliver, the importance of their self-efficacy beliefs about perceived utility may decrease at the post-acceptance stage. In fact, research in social psychology suggests that the behavioral impact of people's general self-efficacy beliefs attenuates overtime [42]. In the context of IT, it is also likely that the effect of CSE may be less salient during the later stages of implementation than the earlier ones. More research is needed to verify this conjecture in the IT context.

Interestingly, while extant knowledge suggests that CSE affects IT usage [15], CSE had no direct bearing on 'Innovate with IT'. This contradictory finding may be attributed to the conceptualization of CSE in this study. Marakas et al. [37] and Agarwal et al. [3] conceptually distinguished task-specific CSE from general CSE and argued for their distinctive behavioral influences. Agarwal et al. [3] further demonstrated the superior predictive power of specific CSE beliefs, relative to general CSE belief, in explaining individual response to specific tasks. Our conceptualization and operationalization of CSE as a general belief may, therefore, undermine the ability to detect the association between CSE and novel use of CITs. Future research may consider examining the effect of individuals' belief in their ability to explore new ways of using CITs.

As hypothesized, the encouragement provided and resources allocated by the management indeed nurtured individuals' creative use of CITs. Unexpectedly, Management Support exerted no influence on Perceived Usefulness; perhaps after direct technology usage, people rely more on personal experience than external influences for shaping their outcome evaluation [7]. Since Management Support represents the kind of social influences that is external to individuals, its effect on usefulness perception might be less salient in the post-acceptance stage.

LIMITATIONS

Like most empirical research, certain limitations inherent in the study must be acknowledged. First, our sample is limited to end users with mandated usage in organizations using a particular type of complex IT. Conclusions drawn in this study are based on a single technology (i.e. ERP packages) and a specific user group (i.e. knowledge workers who use ERP in large manufacturing organizations). Therefore, caution needs to be exercised when generalizing these research results to other technologies or environments. Future research may replicate this study to examine the robustness of the findings across a wide range of information technologies and samples in other organizational contexts.

Furthermore, the data was collected through a single survey study and may have been subject to the threat of common method bias (CMB). Recognizing this limitation, we took several actions to address the potential issue of CMB. First, the instrument was carefully designed to counterbalance the order of items of the predictor and criterion variables [44]. Meanwhile, to reduce scale commonality [44], while a seven-point Likert scale was used for most items, items for CSE were measured at an eleven-point scale. We further performed the Harmon one-factor test [43], after the data collection. A factor analysis combining predictors and criterion variables showed no sign of a single-factor accounting for the majority of covariance. In addition, results of the structural models revealed different levels of significance for path coefficients. The above evidences jointly suggest that CMB should not be a significant concern.

CONTRIBUTIONS

As our understanding of IT adoption and use in early stages of technology diffusion has reached a level of maturity, post-acceptance usage behaviors are the emerging areas that are drawing the attention of many IS scholars. From the perspective of theoretical advancement, this paper represents a critical contribution to the fields of IT usage and implementation, as it is one of the few early studies that specifically looks into post-acceptance usage that is novel in nature. Adapted from the notion of 'Trying to Innovate with IT' [5], we focus on employees' actual novel use of IT, i.e. 'Innovate with IT'. The theoretically deduced model successfully accounts for a significant portion of variance in employees' creative use of complex ITs. The IS Continuance model, managerial intervention (i.e. Management Support), and personal risk-taking tendency towards IT (i.e. PIIT) are all instrumental in understanding individual innovative behavior. Nowadays, firms need to stimulate IT-based innovation and creativity in order to adapt to the ever-changing environments and to maximize their return on IT investment. To cultivate end-user innovation with complex ITs, this paper offers insights into leverage points that managers can use to stimulate individuals' novel use of complex ITs.

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APPENDIX A: MEASUREMENT ITEMS & SOURCES

Construct	Measure	Sources
Confirmation of Expectation (1-7 Likert Scale)	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.	[7]
Satisfaction (1-7 Likert Scale)	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.	[7]
Perceived Usefulness (1-7 Likert Scale)	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.	[17]
Personal IT Innovativeness (1-7 Likert Scale)	PIIT1: If I heard about a new information technology, I would look for ways to experiment with it. PIIT2: Among my peers, I am usually the first to try out new information technologies. PIIT3: In general, I am hesitant to try out new information technologies. (Dropped) PIIT4: I like to experiment with new information technologies.	[1]
Management Support (1-7 Likert Scale)	MS1: Management has provided most of the necessary help and resources to get the employees to use the ERP system quickly. MS2: Management is really keen to see that their employees are happy with using the ERP system. MS3: A central support (e.g. information center) is available to help with problems. MS4: Training courses are readily available for employees to improve themselves in using the ERP system.	[26]
Computer Self Efficacy (0-10 Likert Scale)	I could complete the job using the ERP system, CSE1: if there was no one around to tell me what to do as I go. CSE2: if I had seen someone else using it before trying it myself. CSE3: if I could call someone for help if I got stuck.	[16, 53]
Innovate with IT (1-7 Likert Scale)	IwIT1: I have found new uses of this ERP system to enhance my productivity. IwIT2: I have used this ERP system in novel ways to help my work.	[5]