RECONCEPTUALIZING TECHNOLOGY USE AND INFORMATION SYSTEM SUCCESS: DEVELOPING AND TESTING A THEORETICALLY INTEGRATED MODEL

by

KENG-JUNG YEH

Presented to the Faculty of the Graduate School of

The University of Texas at Arlington in Partial Fulfillment

of the Requirements

for the Degree of

DOCTOR OF PHILOSOPHY

THE UNIVERSITY OF TEXAS AT ARLINGTON

August 2009

ACKNOWLEDGEMENTS

The completion of this dissertation and my PhD study mark a milestone in my life. Many people help me realized this achievement and I can not express my appreciation enough in this short acknowledgement. Dr. James Teng, my advisor, has continuously guided and encouraged me in every way throughout these years at UTA. I have obtained tremendous tacit knowledge for my career from him. My dissertation committee members, Dr. Radha Mahapatra, Dr. Sridhar Nerur, and Dr. Kenneth Price, not only taught valuable courses in my PhD training, but also gave me precious advice for my proposal and dissertation. I thank everyone I have met in the INSY department for creating a friendly and supportive environment, which makes my studying and teaching experience for the past five years a real pleasure.

My dear wife, Tien, has shown immense love, support, and patience during these years while we struggled to balance the pursuit of two PhD degrees while raising two children at the same time. Our lovely daughters, Adeline, who has helped increase both my efficiency and effectiveness by asking repeatedly why I always need to go to school, and Artemis, who always shows big smiles when she sees me after one day’s work, are the most precious gifts from heaven to Tien and me. Last, but not least, I am deeply thankful to Linda and Scott BeVier who include us in their family here, and to my parents, Cheng-Hsin and Chin-Mei, and parents-in-law, Yi-Sang and Li-Hua, who have supported us wholeheartedly throughout this journey.

July 9, 2009

ABSTRACT

RECONCEPTUALIZING TECHNOLOGY USE AND INFORMATION SYSTEM SUCCESS: DEVELOPING AND TESTING A THEORETICALLY INTEGRATED MODEL

Keng-Jung Yeh, PhD

The University of Texas at Arlington, 2009

Supervising Professor: James T.C. Teng

Technology Acceptance Model (TAM) research, which pertains to how an information system can be initially adopted by members of an organization, was born two decades ago and has grown into one of the pivotal theoretical foundations of the information systems (IS) discipline. However, many IS scholars indicate that recent TAM research fails to break the twenty-year-old confinement and provides little intellectual value.

To respond to this call for more intellectual depth in TAM research, this dissertation suggests multiple ways to rejuvenate the research stream. First, Bhattacherjee's IS use continuance model (2001), which is based on the Expectation-Disconfirmation Theory, was adopted as the overall theoretical

foundation. Second, the author reconceptualized the most important construct in the TAM model, i.e., perceived usefulness. Third, a technology use model (TUM), which integrate recent studies about IS use, facilitating conditions, and habit, is proposed. Finally, the author further integrated the technology use model with the IS success model. An empirical study, which involves a sample of 311 business professionals, has provided results that validated most of the proposed constructs and models.

This dissertation covers all contributions listed above and is organized into three independent essays. The first essay examines the concept of "usefulness" in IS literature and proposes new constructs to measure various forms of IS usefulness. The focus of the second essay is the development of a comprehensive model to depict an overall picture on technology use after an extended period of implementation. The final essay discusses the IS success research and proposes an integrated IS success model which incorporates a sound theoretical foundation and the latest research developments. All three essays contain empirical results to support the proposed constructs or models. Significant contributions to research and practice for the IS discipline are identified and discussed in each essay as well.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

Figure Page

LIST OF TABLES

CHAPTER 1

EXTENDED CONCEPTUALIZATION OF PERCEIVED USEFULNESS: EMPIRICAL TEST IN THE CONTEXT OF SYSTEM USE CONTINUANCE

1.1 Abstract

One of the fundamental tenets of the MIS discipline is that an information system can provide value to its users. Technology Acceptance Model (TAM) successfully operationalized such value as the degree that a system can improve users' job performance. The proposed construct, perceived usefulness, has been empirically tested extensively and prove to be the most important factor regarding why people adopt a technology. However, many scholars have called for further theoretical development to enrich this critical construct but not much effort has been put forward (Bargozzi, 2007; Benbasat and Barki, 2007).

This paper applies a fundamental management concept regarding evaluating performance: efficiency vs. effectiveness (Drucker, 1967) to enrich the traditional usefulness construct. Moreover, new types of systems emerge for various purposes other than just improving job performance. For IS users, the system is useful when it can help them get what they desired. Therefore, the motivation to fulfill any of the basic human needs (existence, relatedness, and self-development) can translate into "usefulness" for an IS user. Therefore,

we propose additional usefulness constructs which extend the traditional usefulness construct based on human needs theory.

The motivations to fulfill users' needs can occur only after the system capability has been fully learned by users. Thus, the research must be conducted in a post-adoption context. This study adopts the IS use continuance model (Bhattacherjee, 2001) and uses survey methods on business professionals to empirically test the proposed constructs. The research results have validated most of the proposed constructs. Significant contributions to research and practice for the IS discipline are identified and discussed.

1.2 Introduction

The use of information technology (IT) is a major force in shaping the modern business world (Brynjolfsson, Malone, Gurbaxani, and Kambil, 1994). To be successful, businesses today must harness the power of IT (Carr, 2003; Melville, Kraemer, and Gurbaxani, 2004). Not surprisingly, how a new technology or a new information system can be adopted and accepted by members of an organization is a major area in MIS research (Silva, 2007). Lee, Kozar, and Larsen (2003) estimated that research related to the Technology Acceptance Model (TAM), which was proposed by Davis (1989), constitutes around 10% of major IS academic publications.

In 2007, the *Journal of the Association for Information Systems* (JAIS) published a special issue of "Quo Vadis TAM – Issues and Reflections on

Technology Acceptance Research" (Hirschheim, 2007) to examine this twenty-year-old research track. The importance of technology acceptance literature has been recognized (Goodhue, 2007). However, many researchers also indicated that TAM-related topics have consumed too much research capacity of IS academia (Lee et al., 2003; Straub and Burton-Jones, 2007), stifled the IS research (Benbasat and Barki, 2007), and it must break free from the old school confinement in a more meaningful way (Schwarz and Chin, 2007). Even the founder of TAM agreed that the minor "tweaking" and repeating of TAM are lacking intellectual value for the IS discipline (Venkatesh, Davis, and Morris, 2007).

To respond to this call for more intellectual depth in technology acceptance research, we reconceptualize the most important construct in the TAM model, i.e., perceived usefulness, in the context of IS use continuance. We argue that extended use of a system can encourage new motivations for its users, thus creating different types of "usefulness" of the system. Our reconceptualization presents organized dimensions of usefulness beyond traditional perceived usefulness based on theories of management and human needs, and thus would significantly advance the research in this area, which is a vital part of the theoretical foundation for our field. Accordingly, in this study, we will strive to address these research questions:

1) What is the nature of the “usefulness” construct in existing MIS literature? In other words, what kind of “usefulness” is meaningful in the eyes of the IS researcher?
2) From a theoretical perspective, what are the different dimensions of the “usefulness” as currently conceived, and what are other forms of “usefulness” that are beyond the current conceptualization?
3) What is the appropriate research context to measure these dimensions of the “usefulness” constructs?

This paper is structured as follows. After the introduction, the second section covers IS use continuance studies which focus on the post-adoption stage of IS implementation. Specifically, we use the model proposed by Bhattacherjee (2001) as the test bed of this study. In the third section, we discuss the nature of perceived usefulness and the dimensions within. We further present different forms of “usefulness” that are beyond the traditional view in the fourth section. Research models and hypotheses and also the processes and results of the empirical validation are described in the next three sections. In the final section, the author discusses the contribution, implication, and limitation of this study and future research possibilities.

1.3 IS Use Continuance: What Happened After System Acceptance

Modern IS, such as enterprise systems, are complicated in nature and pervasive in its use throughout the organization (Keil, Mann, and Rai, 2000). New system development techniques, such as agile methodology, involve frequent interactions and multiple system prototypes (Fruhling and De Vreede, 2006). These two trends, along with other changes in recent years, have transformed the nature of the IS implementation challenges from what it was twenty years ago when TAM was introduced (Lucas, Swanson, and Zmud, 2007). Thus, many recent studies focused on the post-adoption (Jasperson, Carter, and Zmud, 2005) stage which TAM is not able to explain.

Based on TRA, TAM uses beliefs and evaluations (perceived usefulness and perceived ease of use) and attitude (toward system use) to predict user's intention to accept a new system. However, after the initial acceptance (post-adoption: Jasperson et al., 2005), some users still might discontinue their use. Research showed that factors influencing such discontinuance decisions are different from those affecting early adoption decisions (Agarwal and Prasad, 1997; Karahanna, Straub, and Chervany, 1999). For example, ease of use is no longer an essential construct in the post-adoption stage (Karahanna et al., 1999).

Building upon Expectation-disconfirmation Theory (EDT, Oliver, 1980), Bhattacherjee (2001) proposed a post-acceptance model of IS continuance (Figure 1.1) to explain the possible discontinuance of an originally adopted IS.

The EDT is a well-accepted theory of consumer behavior, especially regarding consumer satisfaction, post-purchase behavior, and service marketing (Anderson and Sullivan, 1993; Oliver, 1980, 1997; Tse and Wilton, 1988). Major model constructs include expectation (pre-consumption), perceived performance, confirmation, satisfaction, and intention (all post-consumption). Limayem, Hirt, and Cheung (2007) also affirm that Bhattacherjee's model "has a solid theoretical foundation" and "is promising."

As the model suggests, after initial adoption, the user's intention to continue to use the system is determined by his/her satisfaction level on using the system and perceived usefulness of the system. In turn, the extent that the user's expectation has been confirmed or exceeded in the initial use experience, can affect both perceived usefulness and use satisfaction. Ease of use, an important factor for TAM, becomes insignificant while users gain experience in using the IS (Davis, Bagozzi, and Warshaw, 1989; Karahanna et al., 1999). These relationships are depicted in Figure 1.1.

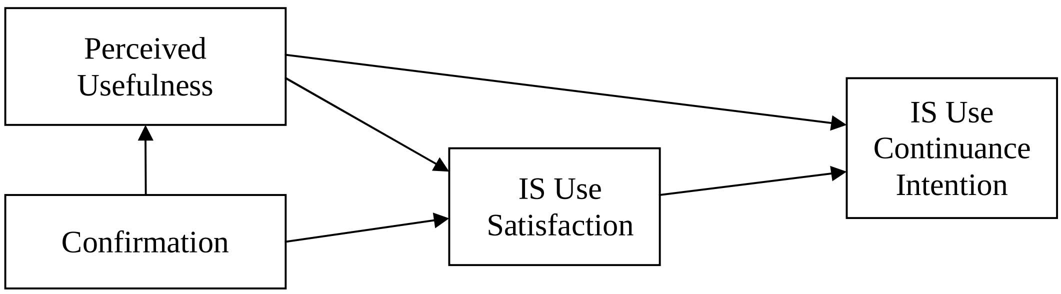

Figure 1.1: Post-Acceptance Model of IS Continuance (Bhattacherjee, 2001)

In contrast to TAM, which predicts based on beliefs, evaluations, and attitudes before users actually gain substantial experience in using the system, the IS use continuance model is based on users' extended experience of using the system and users' satisfaction of the system. Fazio and Zanna (1981) indicated that satisfaction based on actual use experience is more realistic and unbiased than pre-acceptance attitude. Thus, Bhattacherjee's IS Continuance Model (2001) successfully depicted what occurs after the initial system adoption stage.

The development of research on technology acceptance and continuance of use, as briefly summarized above, has made tremendous progress and, in the process, enriched the theoretical foundation of the IS discipline. One common theoretical construct for all of these models is the perceived usefulness. This construct, however, has remained relatively unchanged since the inception of the research stream.

We believe the time is ripe for an expansion and enrichment of this construct in order to make further theoretical advances. In fact, Bagozzi (2007) indicated that "almost no research has deepened TAM in the sense of explaining perceived usefulness …., reconceptualizing existing variables in the model …" Benbasat and Barki (2007) also stated the need for "opening the black box of usefulness" and explanation on "the relationships that can exist between users' perceptions and IT characteristics."

1.4 Enriching the Perceived Usefulness Construct – Efficiency and Effectiveness

Perceived usefulness has been consistently proved as the most powerful predictor for intention to use in the technology adoption and related literature (Venkatesh, Morris, Davis, and Davis, 2003). In the context of IS use continuance, perceived usefulness is also a major construct (Bhattacherjee, 2001). Davis (1989) defines it as "The degree to which a person believes that using a particular system would enhance his or her job performance." According to Venkatesh et al. (2003), concepts similar to perceived usefulness include extrinsic motivation (Davis, Bagozzi, and Warshaw, 1992), relative advantage (Moore and Benbasat, 1991), job-fit (Thompson and Higgins, 1991), and outcome expectations (Compeau and Higgins, 1995; Compeau, Higgins, and Huff, 1999). From the original definition and other related constructs, it is clear that perceived usefulness refers to the value as perceived by users of an information system on improving their job performances.

Therefore, to "open the black box of usefulness" (Benbasat and Barki, 2007), we should examine the concept of job performance. In the history of management as a discipline, Peter Drucker is one of the most influential figures. When companies and managers are still focusing on improving mass production efficiency, his book **The Effective Executive** (1967) has proposed the concept of effectiveness which can be considered as the foundation of the knowledge workers concept and the information society (Drucker, 1985).

Efficiency, as defined by Peter Drucker, is “the ability to do things right” (Drucker, 1967, p. 2). Efficiency, however, is not sufficient for an effective executive who must also possess the quality of effectiveness. According to Peter Drucker, this is “getting the right things done” (1967; p. 1). Therefore, it is possible for a manager to carry out certain activities well (i.e., efficiently) but, unfortunately, these activities are totally unnecessary or even harmful to the organization’s strategic objectives. In other words, by conducting these activities, the manager is efficient but not effective. It is clear, therefore, that job performance has two vital dimensions: efficiency and effectiveness. This is the basis for this proposal to conceive perceived usefulness as consisting of these two reflective dimensions. The relationship is not formative (Petter, Straub, and Rai, 2007) because the author can readily name other forms of “usefulness” such as hedonic value (Wetzels, Odekerken-Schroder, and Van Oppen, 2009).

Interestingly, one previous empirical study on the psychometric properties of Davis’ perceived usefulness and perceived ease of use scales has provided preliminary evidence to support the author’s contention above. Using traditional Multi-Trait Multi-Method (Campbell and Fiske, 1959) and common factor analysis techniques to analyze the pool of items from these two scales, Adams, Nelson, and Todd (1992) re-established the two-factor structure, i.e., perceived ease of use and perceived usefulness, with good reliability and validity. However, Segars and Grover (1993) found different results when the structural equation modeling (SEM) method is used. Their SEM analyses on the pool of items reveal a three-factor structure. While ease of use remained a distinct factor, the perceived usefulness broke into two factors, which the researchers interpreted and labeled as “usefulness” and “effectiveness.” They have shown that the three-factor solution yields better model-fit and psychometric properties than the two-factor solution.

The perceived efficiency reflects the IT/IS users’ perceptions on how the IT/IS can help them to “do thing right,” i.e., improve their productivity on the job. Perceived efficiency is defined as “the extent to which an IS user believes that using the system can increase the output and/or decrease the cost on performing his or her job activities.” On the other hand, the perceived effectiveness measures the degree that the users feel the IT/IS can help them “get the right things done.” In order to achieve this, existing routines for doing work may not be sufficient. Modern information system, such as decision support systems and data warehousing, may provide information that facilitates not only opportunities for new decision alternatives, but also new solutions (Ward, Daniel, and Peppard, 2008). Accordingly, we define perceived effectiveness as “the extent to which IS users believe that using the system enables them to properly identify the problems and appropriate solutions that facilitate the accomplishment of their goals and objectives on the job.”

The extended usefulness scale, which has two reflective dimensions (perceived efficiency and perceived effectiveness), will be referred to as “perceived extended usefulness.” Similar arrangements can be found at

Wetzels et al. (2009) where experiential value has two reflective dimensions: hedonic value and utilitarian value. As the dimensions are based on two theoretically distinct concepts, perceived extended usefulness is a second-order reflective construct (see Figure 1.3). This is the first stage in the two-stage process of reconceptualizing the notion of IS usefulness. The next stage will continue in the following section.

1.5 Extending the Perceived Usefulness Construct – Beyond Job Performance

Both perceived effectiveness and perceived efficiency are based on the IS user's belief that the IS can fulfill the need for better job performance. Is improving job performance the only driving force for an employee to adopt and continually use a new IS? Researchers have found evidence that challenges this contention. According to Lee et al. (2003), system quality, training, compatibility, computer anxiety, self-efficacy, enjoyment, computing support, and experience are the most common factors introduced in the TAM-related models. Legris, Ingham, and Collerette (2003) also indicated that TAM should incorporate behavioral and social variables pertaining to the system adoption process. Based on the theories on users' fundamental needs as human beings (Alderfer, 1969), Glassberg (2000) reconceptualized and extended the perceived usefulness construct and empirically validated it in the context of web use. We try to follow a similar line and argue that the extended usefulness constructs can be applied to general IS and technology use.

1.5.1 Theory of Human Needs – Existence, Relatedness, and Growth

Maslow (1943) proposed a hierarchy of human needs which consists of physiological, safety, social, esteem, and self-actualization (from the bottom to the top level). Only when a need at the lower level has been satisfied, can the one above become active. However, this hierarchical characteristic has never been empirically proven (Pinder, 1998).

Alderfer (1969) simplified the Maslow's five-level human needs to these three levels: existence, relatedness, and growth needs and called it ERG Theory (figure 1.2). These three needs are all active at the same time and no longer require one another as the prerequisite. The existence need refers to Maslow's physiological and safety needs, which refers to an individual's need to maintain status and resources. The relatedness need reflects the intention of an individual to communicate with other human beings and corresponds to Maslow's social need and part of esteem need. The growth need, similar to Maslow's esteem (only partial) and self-actualization needs, relates to the urge of an individual to fully develop his/her potential.

1.5.2 The Perceived Needs Fulfillment

From the ERG theoretical perspective, the need to use an IS on carrying out an assigned job duty more efficiently and effectively can be comprehended as the existence need. Learning how to use a new and useful IS enriches the skill set and knowledge of an employee. Thus, the employee's social status and resources can be sustained or further strengthened. Failing to achieve this will usually result in loss of status and power.

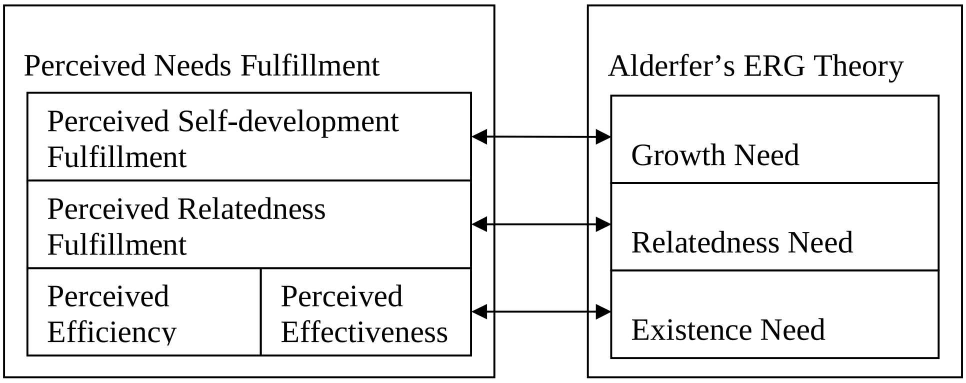

Figure 1.2: Perceived Needs Fulfillment and ERG Theory

Relatedness and growth needs are not included in the proposed perceived extended usefulness measure. However, Legris et al. (2003) point out that TAM should include behavioral factors to overcome its current limit of predictive power (around 40%) on system use. Au, Ngai, and Cheng (2008) also clearly indicated this: "The technology acceptance model focuses mainly on how useful information systems are in meeting the end user's job performance-related needs, whereas the higher level of intrinsic needs have largely been ignored."

Given the rapid advancements on information systems, system development methodology, and system implementation processes in recent years (Keil et al., 2000; Fruhling and De Vreede, 2006; Lucas et al., 2007), exploring behavioral aspects of the IS adoption phenomenon is essential for the research stream to break the confinement of TAM (Legris et al., 2003). Similar to Glassberg (2000), we will attempt to incorporate relatedness and self-development needs in a broader construct for usefulness. We will refer this broad construct as "Perceived Needs Fulfillment" in using an information system. The proposed construct is a formative construct (Petter et al., 2007) based on the ERG theory of human needs (Alderfer, 1969) and thus is by definition consisted of three distinct components: perceived extended usefulness (work performance fulfillment), perceived relatedness fulfillment, and perceived self-development fulfillment. The overall structure of several theoretical constructs we discussed earlier is presented in Figure 1.3.

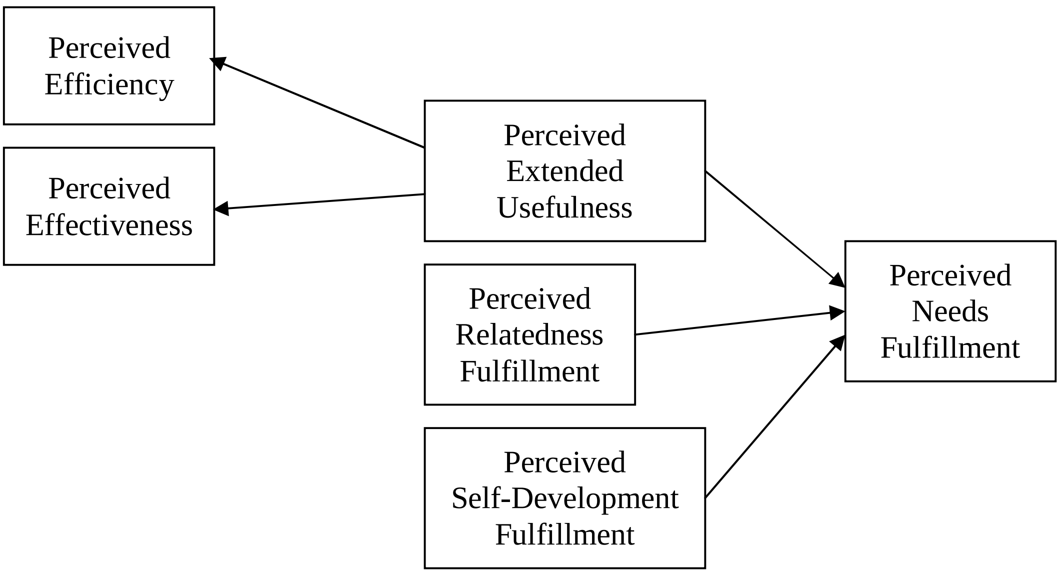

Figure 1.3: Perceived Extended Usefulness and Perceived Needs Fulfillment

1.6 Research Model and Hypotheses

In previous sections, the author proposed two improved constructs to extend the traditional perceived usefulness to newly proposed constructs: Perceived extended usefulness and perceived needs fulfillment. Thus, the author presents two research models to examine the relationship between model constructs. It is argued that an IS use continuance context should be utilized for both research models. Only after operating the system for an extended period, can the users fully understand the system and leverage its potential in various ways. Bhattacherjee and Premkumar (2004) also suggest that IS users' perceptions change over time as they use a system. Among all usefulness constructs discussed above, the perceived efficiency is relatively easy to be evaluated because it is usually a fundamental requirement for an IS. However, it will take more time for the users to identify how to utilize their new tool (the system) for fulfilling the needs of work more effectively, relating more closely to colleagues, and enhancing self-development.

Therefore, both research models are based on Bhattacherjee's post-acceptance model of IS continuance (2001, Figure 1.1). Each of the proposed models adopts one proposed construct: model 1 using perceived extended usefulness (Figure 1.4) and model 2 using perceived needs fulfillment (Figure 1.5).

Per EDT, a consumer's repurchase intention is determined by his or her satisfaction on initial consumption experience. Bhattacherjee (2001) has presented and empirically tested such a relationship in an IS use continuance context. DeLone and McLean (2003) put the satisfaction-intention linkage in the center of the Extended IS Success model. Briggs, Reinig, and De Vreede (2008) claim that they experienced many cases in which users' dissatisfaction from initial use caused discontinuance on further system utilization. Thus, the first hypothesis of our model 1 (and model 2) is:

H1: Users' level of satisfaction with IS use is positively associated with their IS use continuance intention.

The essence of EDT is that actual consumption experience will be compared with original expectation and the resulting confirmation (when experience is better than expectation) or disconfirmation (when experience fails to meet expectation) will lead to satisfaction (when expectation is met) or dissatisfaction (when expectation is not met). Various anecdotal cases in IS domain supporting these contentions can be found in the literature and trade magazines (Bhattacherjee, 2001). Therefore, the second hypothesis for both research models is:

H2: Users' extent of confirmation is positively associated with their satisfaction with IS use.

TAM established the importance of perceived usefulness and its two major relationships (usefulness-attitude and usefulness-intention) in the model (Davis, 1989). The enrichment of the traditional usefulness construct, i.e., perceived extended usefulness, does not change the nature within both usefulness constructs. The instrumentality of job performance improvement is still the core of “usefulness.” Moreover, context change (initial adoption to use continuance) will not be a problem because such reward-seeking behaviors are independent of contextual factors (Bhattacherjee, 2001). Thus, we argue that the relationship between usefulness and the user’s affective reaction (attitude or satisfaction) will be maintained, even if the context has shifted from initial adoption to use continuance. Similarly, the perceived extended usefulness also leads to use continuance intention.

H3: Users’ perceived extended usefulness of IS use is positively associated with their satisfaction with IS use.

H4: Users’ perceived extended usefulness of IS use is positively associated with there IS use continuance intention.

Similar to the linkage between ease of use and usefulness in TAM, the author argues that the confirmation is positively associated with perceived extended usefulness in the model. According to the cognitive dissonance theory (CDT: Festinger, 1957), the IS users will avoid cognitive dissonance and adjust their perceptions on extended usefulness of the system to cope with what they feel in their use experience. Therefore, confirmation (when experience exceeds expectation) can lead to a change to higher usefulness and disconfirmation can result in a lower usefulness perception. Thus:

H5: Users’ extent of confirmation is positively associated with perceived extended usefulness of IS use.

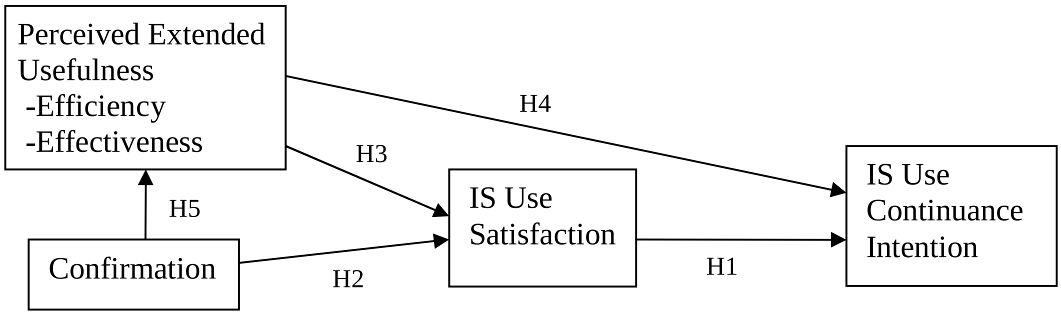

Figure 1.4: Research Model 1
Predicting Continuance Intention Using Perceived Extended Usefulness

Next, the author examines the distinction between perceived extended usefulness and traditional perceived usefulness. By clarifying and capturing both essential components of IS usefulness, it is predicted that perceived extended usefulness can better explain the variance in IS use satisfaction and IS use continuance intention than the traditional perceived usefulness measure. Thus:

H6a: Perceived extended usefulness is a better predictor of IS use satisfaction than traditional perceived usefulness.

H6b: Perceived extended usefulness is a better predictor of IS use continuance intention than traditional perceived usefulness.

For model 2, three hypotheses that were formulated by replacing perceived extended usefulness with perceived needs fulfillment (H1 and H2 relationships stay the same as in model 1) are inspected. As described in previous sections, perceived needs fulfillment contains perceived extended usefulness plus two extra components: relatedness fulfillment and self-development fulfillment.

From the needs fulfillment perspective, the relationship between needs fulfillment and satisfaction has received empirical support in a marketing context (Oliver, 1995). If one sees the perceived extended usefulness (as in model 1) is an existence need fulfillment, then adding relatedness and self-development need fulfillments will undoubtedly increase the association coefficient to the hypotheses in model 1 (H3 and H4). Thus:

H7: Users' perceived needs fulfillment of IS use is positively associated with their satisfaction with IS use.

H8: Users' perceived needs fulfillment of IS use is positively associated with there IS use continuance intention.

Similarly to H5, CDT applies to the relationship between IS use confirmation and perceived needs fulfillment as well. IS users tend to minimize the perception gap (cognitive dissonance) toward the system, thus positive confirmation (use experience exceeds expectation) will tend to raise their perceived needs fulfillment. Thus:

H9: Users' extent of confirmation is positively associated with their perceived needs fulfillment from IS use.

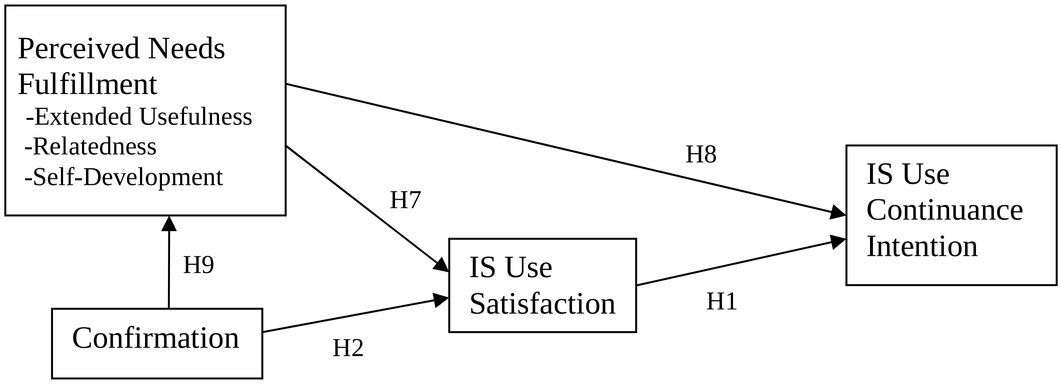

Figure 1.5: Research Model 2
Predicting Continuance Intention Using Perceived Needs Fulfillment

1.7 Research Methodology

1.7.1 Data Collection

Research data were collected using the survey method from students in graduate-level college of business courses at a large state university in the South. A small number of senior undergraduate students were among the subjects since some classes have combined graduate and advanced undergraduate sections. Subjects identified a recently adopted IS and answered questions based on his or her experience with using that system. The target population is knowledge workers who heavily rely on systems to perform their job.

It was suggested that subjects consider several factors regarding the system they had chosen. First, the system should be considered important to their job so the subjects were more serious in their response and their responses could be better calibrated and of higher quality. Second, the system should be officially supported by their IT staff to make sure that the system is a formal information system sanctioned by the organization. Third, the system supplies information to the user regularly so that it is different from common productivity tools such as a spreadsheet. Last, users should focus on only one module when it is a large system such as an ERP system, since the unit of analysis for the study is a specific type of system with a specific type of output rather than a collection of systems. It was also asked that the respondents identify three major job activities or decisions in their job and what information they obtained from the identified system to support those activities or decisions. This would ensure that the subjects will be mentally better prepared for the questions that follow.

1.7.2 Construct Development and Pilot Test

There are seven constructs involved in this study: perceived efficiency, perceived effectiveness, relatedness fulfillment, self-development fulfillment, confirmation, satisfaction, and use continuance intention. Almost all construct items in this research are adapted from prior studies, except two items in perceived effectiveness. The traditional perceived usefulness items (Davis, 1989) can be categorized as either perceived efficiency or perceived effectiveness by the result presented in Segars and Grover (1993). Based on the findings of Segars and Grover (1993), all items were retained from the perceived usefulness items (four for perceived efficiency and two for perceived effectiveness) and adding two new items to enhance the perceived effectiveness dimension. Discriminant validity was examined at both item and construct levels in the measurement model section below.

All items adapted and their sources are listed in the appendix. Perceived relatedness fulfillment items are from Au et al. (2008) and have been validated in Alter (1999) and Eason (1988). Perceive self-development fulfillment items are also from Au et al. (2008) and are adapted from Regan and O'conner (1994), Rosenberg (1997), and Eason (1988). Both relatedness and self-development constructs are a three-item seven-point Likert scale anchored from "Strongly Agree" to "Strongly Disagree." IS use confirmation items are from Bhatacherjee (2001). Confirmation is measured by seven-point Likert scales with anchors from "Strongly Agree" to "Strongly Disagree" and involves phrases such as "…better than what I expected" in the item statements. This measurement scheme is recommended by Spreng and Page (2003).

The IS user satisfaction items are adapted from three sources: Au et al. (2008), Briggs et al. (2008), and Bhattacherjee (2001). Items for the satisfaction scale attempt to capture subjects' affective responses with phrases such as "I am content…," "I am pleased…," "I have positive feelings…." Subjects indicate their agreement by answering a seven-point Likert scale from "Strongly Agree" to "Strongly Disagree." For IS use continuance intention, items were adopted from Bhattacherjee (2001) whose study is also for a use continuance context. This construct is also based on a seven-point scale from "1: Strongly Disagree" to "7: Strongly Agree."

To ensure content validity (Straub, Boudreau, and Gefen, 2004), these measurement scales were pilot-tested on experts (IS faculty and PhD students). Several improvements were made based on pilot test feedbacks and expert suggestions.

1.8 Data Analysis

1.8.1 Data Analysis Methodology

The author used the Partial Least Square technique (PLS: Fornell and Bookstein, 1982) to conduct data analysis for this research study. Compared to the Structural Equation Modeling (SEM) technique, PLS can handle formative constructs and does not require the normality and independence assumptions (Chin and Newsted, 1999). The software used is SmartPLS 2.0 (Ringle, Wende, and Will, 2005). According to Lee et al. (2003), the average sample size of 101 major TAM publications from 1989 to 2003 is 211.

1.8.2 Data Screening, Data Characteristics, and Control Variable Analysis

A total of 358 survey forms were collected from eleven classes. Forty-seven samples were removed because of various reasons, such as monotone or patterned responses, too many missing answers, mistaking software productivity tool for a system as a basis for answering the questionnaire. The final dataset contains 311 valid responses. The author also checked univariate outliers (Hair, Black, Babin, Anderson, and Tatham, 2006) and found several outliers on control variable items. After direct inspection, all samples with outlier were retained because they are valid responses and later the control variable (Organization size) proved to be insignificant.

Table 1.1 summarized the demographic information. The sample characteristics reflected typical white-collar knowledge workers who utilize information systems in an office environment of various industries.

We tested eleven control variables, including age, education, gender, organization industry, organization size, job title, tenure with organization, tenure with current position, voluntariness, system adoption time, and system importance. The test result showed that only system importance is significantly linked to perceived extended usefulness (for model 1) and to perceived needs fulfillment (for model 2). Thus, system importance is to be incorporated in both models.

Table 1.1 Data Characteristics

Demographic Variable	Category	Count	Percentage
Age	20 and below	4	1.3
	21-30	178	57.2
	31-40	90	28.9
	41-50	31	10.0
	51-60	6	1.9
Education	High School Degree	8	2.6
	Associate Degree	6	1.9
	Bachelor Degree	194	62.4
	Master Degree	95	30.5
	Doctorate Degree	4	1.3
Gender	Male	188	60.5
	Female	120	38.6
Organization Industry	Manufacturing	46	14.8
	Banking/Insurance/Financial Service	55	17.7
	Hotel/Entertainment/Service Industry	14	4.5
	Construction/Architecture/Engineering	27	8.7
	IT/Telecommunications	20	6.4
	Consulting/Business Service	13	4.2
	Health Care	20	6.4
	Government/Military	23	7.4
	Education	13	4.2
	Other	78	25.1
Job Title	Employee	150	48.2
	Manager	60	19.3
	Executive	19	6.1
	Professional	13	4.2
Organization Size	Range from 2 to 300,000; Mean 11,796 (employees)		
Tenure with Organization	Range from 0.1 to 30; Mean 4.53 (years)		
Tenure with Current Position	Range from 0.1 to 25; Mean 2.67 (years)		
System Adoption Time	Range from 1 to 242; Mean 37; Mode 24 (months)		

1.8.3 Common Method Variance Analysis

If the research design requires that the independent and dependent variables cannot be obtained from different sources and measured in different contexts, common method bias (CMB) will be a concern (Podsakoff and Organ, 1986). However, Malhotra, Kim, and Patil (2006) indicate that research in IS field are more robust against the CMB (so they call it CMV [Common Method Variance] instead of CMB). The concrete constructs, such as satisfaction and performance, which are often seen in IS studies and also this study, are less likely to be affected by CMV than abstract constructs which are often utilized in social science disciplines (Cote and Buckley, 1987). Moreover, IS researchers focus on IT artifacts, not a person who can be emotionally associated with the respondent, thus the surveys regarding a system, such as what were used in this study, are more likely to obtain true opinion because no social sensitivity is involved.

Rindfleisch, Malter, Ganesan, and Moorman (2008) also indicated that when key constructs are concrete and externally-oriented, likelihood of response biases are low, and measurement format and scales are heterogeneous, cross-sectional studies are comparable with longitudinal studies in terms of result validity. Malhotra et al. (2006) empirically conducted a reanalysis on 216 past IS studies and found that the CMV generally only inflated the correlation by 0.1 or less and most significant relationships remain significant after controlling for CMV.

However, the author still tries to minimize the existence of CMV. Several techniques were employed as suggested by Podsakoff, MacKenzie, Lee, and Podsakoff (2003) in the design of the questionnaire and collection of the data. When designing the questionnaire, demographic items were used to separate construct items into chunks and several different ways were used to obtain measures so that psychological, proximal, and methodological separations can be achieved. When collecting the data, the facilitator informed the respondents that the survey is anonymous and there are no right or wrong answers, so that respondent anonymity can be protected and evaluation apprehension can be reduced.

Next, two approaches were taken as suggested by Podsakoff et al. (2003) and Liang, Saraf, Hu, and Xue (2007) to examine the potential CMV. The first approach, Harman's one-factor test, utilizes exploratory factor analysis on all measurement items which checks if there is a universal factor which relates to most items. Liang et al. (2007) is the first study that applied a CMV-control technique using PLS. To conduct this examination, a "method" latent variable needs to be created and linked to all manifest variables. If all links are not significant and the variance extracted by method variable is much less than variance extracted by substantive model factors, then the CMV is not a concern. Both models 1 and 2 passed these two CMV test methods. Thus, it can be concluded that CMV is not a threat to this study.

1.8.4 Validities of Measurement Scales

The author first examined the multicollinearity of all measurement items (Diamantopoulos and Winklhofer, 2001) and removed two satisfaction items (Satis2 and Satis4) because the variance inflation factor (VIF) exceeds ten. Next, convergent and discriminant validity were inspected by checking the loading of individual manifest variable to its corresponding latent variable. Higher order reflective constructs and formative constructs are skipped because such checkups are not meaningful to them (Petter et al., 2007). Thus, perceived extended usefulness and perceived needs fulfillment are not included in this analysis. All item loadings on their own latent variable are higher than 0.7, thus indicating sound convergent validity (Gefen and Straub, 2005).

To establish discriminant validity, first look at correlations of individual items to constructs. Since no items from other constructs loaded higher than a specific construct's own items, this is indicative of discriminant validity. However, the difference between efficiency and effectiveness item loadings is small. The loadings of the four effectiveness items are 0.857, 0.888, 0.878, 0.906 to itself and 0.773, 0.789, 0.842, 0.776 to efficiency. For efficiency items, the loadings to itself are: 0.913, 0.897, 0.928, 0.945 and the loadings to effectiveness are 0.736, 0.758, 0.713, 0.837. Thus, Effecti1 and Efficien3 were dropped to improve the discriminant validity between perceived effectiveness and perceived efficiency constructs. The details of the loading coefficients after item dropping are in Table 1.2 for both models.

To further affirm discriminant and convergent validity, composite reliability and average variance extracted (AVE) were calculated. The right part of Table 1.3 shows the correlations between main constructs and the diagonal elements are the square roots of AVE scores. These AVE square roots must be the highest compared to other correlation coefficients to show satisfactory discriminant validity. Constructs in both models satisfied this criterion. Internal consistency can be examined by composite reliability and AVE. A composite reliability should be higher than 0.7 to indicate good internal consistency (Hair et al., 2006). For AVE, the standard is 0.5 (Fornell and Larcker, 1981). It was found that all constructs in both models were well over the cut-off values thus exhibiting excellent internal consistency. Table 1.3 summarized composite reliability and square root of AVE for major constructs. Overall, the measurement model showed good results in various validity checks.

Table 1.2 Correlations of Individual Items to Constructs

	Use Continuance Intention	IS Use Confirmation	Perceived Effectiveness	Perceived Efficiency	Relatedness Fulfillment	IS User Satisfaction	Self-Development Fulfillment
CUseInten1	**0.941**	0.685	0.577	0.635	0.503	0.744	0.517
CUseInten2	**0.929**	0.685	0.530	0.597	0.479	0.746	0.516
CUseInten3	**0.797**	0.413	0.371	0.443	0.264	0.533	0.341
Confirm1	0.648	**0.903**	0.595	0.669	0.491	0.717	0.539
Confirm2	0.614	**0.904**	0.529	0.613	0.398	0.698	0.465
Confirm3	0.556	**0.861**	0.509	0.570	0.403	0.622	0.447
Effecti2	0.447	0.495	**0.891**	0.741	0.485	0.452	0.436
Effecti3	0.511	0.572	**0.902**	0.686	0.577	0.522	0.574
Effecti4	0.569	0.601	**0.926**	0.823	0.517	0.557	0.512
Efficien1	0.611	0.644	0.759	**0.923**	0.459	0.545	0.446
Efficien2	0.572	0.640	0.782	**0.915**	0.436	0.570	0.443
Efficien4	0.584	0.652	0.768	**0.945**	0.474	0.575	0.467
RelatNF1	0.463	0.501	0.576	0.472	**0.910**	0.470	0.741
RelatNF2	0.383	0.378	0.494	0.423	**0.873**	0.393	0.678
RelatNF3	0.458	0.440	0.505	0.443	**0.937**	0.443	0.745
Satisf1	0.683	0.714	0.515	0.545	0.442	**0.936**	0.474
Satisf3	0.762	0.750	0.562	0.603	0.457	**0.963**	0.509
Satisf5	0.699	0.688	0.503	0.533	0.435	**0.915**	0.519
Satisf6	0.742	0.730	0.541	0.603	0.476	**0.952**	0.520
SelfDNF1	0.497	0.506	0.542	0.460	0.794	0.502	**0.906**
SelfDNF2	0.471	0.495	0.485	0.416	0.724	0.475	**0.939**
SelfDNF3	0.485	0.513	0.522	0.476	0.691	0.512	**0.929**

Table 1.3 Correlation Matrix and Composite Reliability
for Principal Constructs

Construct	Composite Reliability	Mean	Standard Deviation	INT	CFM	EFC	EFI	RF	SAT	SF
Use Continuance Intention (INT)	0.920	4.540	1.893	**0.89**						
IS Use Confirmation (CFM)	0.919	4.423	1.369	0.68	**0.89**					
Perceived Effectiveness (EFC)	0.932	4.890	1.536	0.56	0.61	**0.91**				
Perceived Efficiency (EFI)	0.949	5.170	1.495	0.64	0.70	0.83	**0.93**			
Relatedness Fulfillment (RF)	0.933	3.840	1.732	0.48	0.49	0.58	0.49	**0.91**		
IS User Satisfaction (SAT)	0.969	4.300	1.589	0.77	0.77	0.56	0.61	0.48	**0.94**	
Self-Development Fulfillment (SF)	0.947	3.980	1.784	0.52	0.55	0.56	0.49	0.80	0.54	**0.93**

Diagonal elements (Bolded) in the correlation matrix are square root of AVE scores.

1.9 Research Result

1.9.1 Structural Model

PLS structural model presents the path coefficient and t-value of each directional relationship between constructs. The path coefficients in PLS structural model are similar to the standardized beta coefficients in a regression relationship (Agarwal and Karahanna, 2000). The t-values are calculated by repetitive bootstrapping procedures, using 300 resampling iterations for both models. The structural model outcomes are presented in Figure 1.6 (model 1) and Figure 1.7 (model 2). Except for the construct of perceived relatedness fulfillment, all other relationships are highly significant ($p<0.01$) and all R^2 are higher than 55%.

After removing perceived relatedness fulfillment and rerunning the structural model, the coefficient of perceived extended usefulness to perceived needs fulfillment changes from 0.78 to 0.77 and the coefficient of self-development fulfillment to perceived needs fulfillment changes from 0.36 to 0.34. Both relationships remain significant at $p<0.01$ level. Thus, the original structural model (Figure 1.7) is presented to incorporate information about relatedness fulfillment.

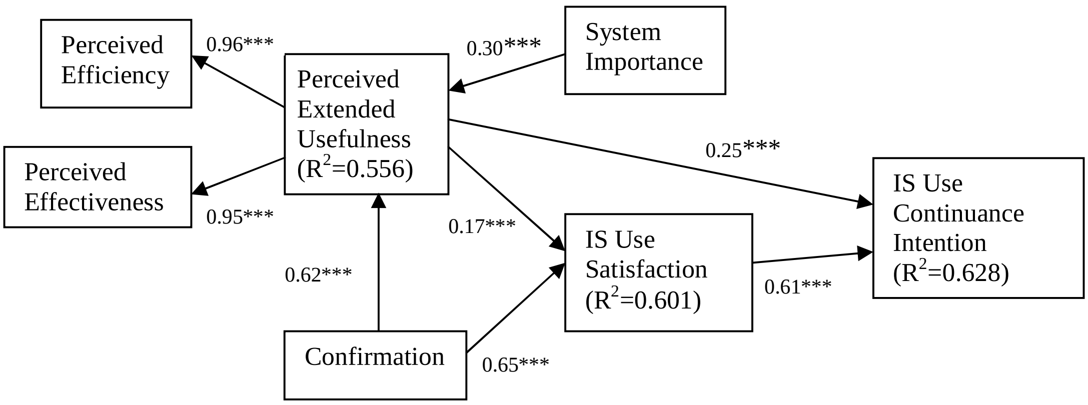

Figure 1.6 Structural Model for Research Model 1 (***: significant at $p<0.01$)

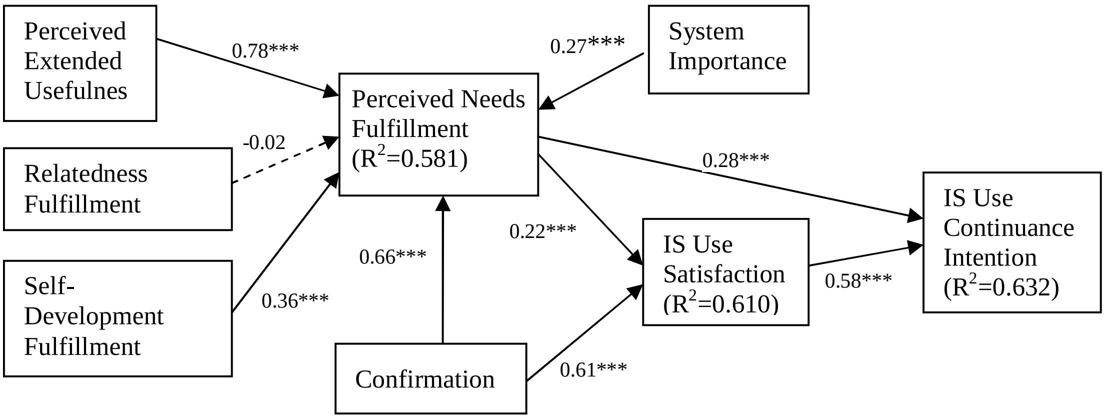

Figure 1.7 Structural Model for Research Model 2 (***: significant at $p<0.01$)

1.9.2 Hypotheses Testing

H1 – H5 and H7 – H9 are all strongly supported ($p<0.01$) by the empirical outcome of the structural model. However, H6a and H6b are not supported. The hypotheses testing results are summarized in Table 1.4. If traditional perceived usefulness (Davis, 1989) is used in the model, the coefficients of its predicting paths are 0.17 (satisfaction) and 0.25 (use continuance intention) and corresponding R^2 are 0.601 (satisfaction) and 0.626 (use continuance intention). All figures are almost the same compared to those with perceived extended usefulness. Thus, one cannot come to a conclusion that perceived extended usefulness is a better predictor of satisfaction and use continuance intention than traditional perceived usefulness.

Table 1.4 Summary of Hypothesis Testing

Model	Hypothesis	Relationship	Result
Models 1&2	H1	Satisfaction - Use Continuance Intention	Supported
Models 1&2	H2	Confirmation - Satisfaction	Supported
Model 1	H3	PEU - Satisfaction	Supported
Model 1	H4	PEU - Use Continuance Intention	Supported
Model 1	H5	Confirmation - PEU	Supported
Model 1	H6a	PEU is a better predictor of Satisfaction than PU	Not Supported
Model 1	H6b	PEU is a better predictor of Use Continuance Intention than PU	Not Supported
Model 2	H7	PNF - Satisfaction	Supported
Model 2	H8	PNF - Use Continuance Intention	Supported
Model 2	H9	Confirmation - PNF	Supported

PEU: Perceived Extended Usefulness PNF: Perceived Needs Fulfillment
PU: Perceived Usefulness

1.10 Discussion and Conclusion

1.10.1 Discussion

The high explanatory power of the research models is reflected in the high R^2 of model constructs. The variance in the endogenous constructs can be accounted for from 55% to 63%. These numbers are better than the corresponding figures which range from 20% to 41% in the original Bhattachejee (2001) paper. While Bhattachejee's research (2001) employs customers of an online banking system, this study's research population includes business professionals using an IS in an organizational setting. It is believed that these results truly reflect the relationships among the model constructs because study subjects representing a cross section of IS users in a variety of real businesses. Therefore, the IS use continuance model has better prediction powers for systems in an organizational setting.

Perceived efficiency and perceived effectiveness are conceptually different and have been widely applied in various disciplines. In this paper, both constructs have been confirmed using confirmatory factor analysis in PLS. The correlation between these two constructs is relatively high, reflecting the fact that modern information systems help their employees get jobs done in both efficient and effective ways.

It is hypothesized that this perceived extended usefulness construct would be a better predictor of satisfaction and use continuance intention, but the result did not support the hypotheses (H6a and H6b). This is perhaps not surprising, since the original items of traditional perceived usefulness might already fully account for both the efficiency and effectiveness dimensions, as Segars and Grover (1993) have shown. These two dimensions are still the main portion of the general system usefulness, i.e. the perceived needs fulfillment construct. The perceived extended usefulness links to perceived need fulfillment with a higher coefficient of 0.76 than 0.36 for self-development fulfillment.

It is argued here that the result of insignificance on relatedness fulfillment might be due to population characteristics. The survey clearly focused on the system that is important to user's job in business environment, thus emphasizing the job performance dimensions. Moreover, from the system information collected in the survey, one can hardly find systems with social dimensions, such as group supporting systems, knowledge management systems, or email systems. Consequently, the component of relatedness fulfillment cannot be recognized in results from this research.

1.10.2 Contribution to Research

This paper reaffirms that the traditional usefulness construct is rooted in work performance, and it should be a reflective construct which contains two dimensions: efficiency and effectiveness. The author adapted original Davis items and empirically demonstrated the existence of the two dimensions. Although the perceived extended usefulness scale did not lead to more predictive power (hypotheses H6a and H6b not supported), this work did move Segar and Grover's work (1993) forward by fully developing the two dimensions of usefulness and rigorously testing them using new methodology and with business professionals.

Moreover, the author extends the "usefulness" concept based on the ERG theory (Alderfer, 1969) and conceptualized perceived needs fulfillment construct based on findings in Au et al. (2008). This paper empirically demonstrated the existence of self-development needs fulfillment. Thus, it is confirmed that an information system can be useful not only in improving user's job performance but also in satisfying the user's need to seeking self growth. Such findings also answered the call for incorporating more behavioral components in the models of technology acceptance studies (Lee et al., 2003). As indicated earlier, the insignificance of relatedness fulfillment is likely due to a limitation of the study. It is also believed that the construct of perceived needs fulfillment can be applied to various information systems and technologies because it is based on a universal theory of human needs.

Many new domains of the IS discipline, such as E-Commerce and social computing, are not confined in an organizational setting. Thus, the "usefulness" involved in those research domains is less likely to be only related to job performance. In this paper, six constructs were presented (perceived efficiency, perceived effectiveness, perceived extended usefulness, relatedness fulfillment, self-development fulfillment, and perceived needs fulfillment) to measure the usefulness of an IS. It is believed that this would contribute to most of the IS research streams which involve the perceived benefits of a system.

The research design of this study contributes to resolving a common methodological issue in technology acceptance studies: generalizability of research findings. In most TAM studies, the research data is collected from only a homogeneous group of subjects using one information system and carrying out a single task (Lee et al., 2003). From recent research on IS use, it is clear that the utilization of a system is a complex phenomenon involving the system, the user, and the task (Jasperson et al., 2005; Burton-Jones and Straub, 2006). Thus, applying the research result to all combinations of systems, users, and tasks is problematic.

The theoretical setting of TAM caused this generalizability problem. Since the phenomenon studied is the initial adoption, researchers have to locate a setting that covers early training and preliminary use of a new IS. However, this study's models, which are theoretically positioned in a use continuance context, remove this limitation. Therefore, the conclusion of this study can be generalized to a broader spectrum of IS, task, and users.

1.10.3 Contribution to Practice

For IS practitioners, this conceptualization of system usefulness can be helpful toward clarifying the goals of a new technology in the planning phase. Each type of usefulness can be linked to various goals. Extended usefulness is relevant to efficiency and/or effectiveness improvements. Relatedness is regarding enhancement of interaction among employees, so such goals can be linked to knowledge creation, culture, team spirit, or leadership building. Self-development can be relevant to training, performance evaluation, and career development.

Later in the technology implementation phase, the instruments developed in this research can be a potent tool for practitioners in diagnosing above-mentioned goal attainments. The instruments can also be used on legacy systems to determine how the current system really contributes to individual employees and if the new system can fully replace the legacy system in terms of those "usefulness."

1.10.4 Limitations and Future Studies

The research findings are based on a broad selection of many different types of systems. Thus, the various relationships found represent a general pattern. However, this general pattern may not hold for a group of users for a specific type of information system. As discussed earlier, the relatedness fulfillment might be the main component of perceived needs fulfillment in a survey targeting social networking system or knowledge management system users.

Some scholars raised the concern that using a student population might limit the generalizability of a study. However, the students who responded to this survey are real business professionals with real work experience. The demographic data of the subjects also showed that the samples resemble the general white-collar knowledge workers (Table 1.1). In addition, as indicated earlier, this research has improved on the generalizability issue of TAM studies by collecting data on various systems, users, and tasks. Thus, using a student population does not compromise the validity of this research.

Future research may wish to address the limitations faced in the current study. Applying the new “usefulness” constructs, especially the perceived needs fulfillment, on different type of systems, technologies, or populations can better reveal the robustness of the proposed constructs, especially on the component that was not found to be significant in the current study -- the relatedness fulfillment. For example, research regarding knowledge creation or social networking in a business setting can be promising for such empirical validation.

The theoretical model of this paper can be further extended as well. Future studies may examine how use continuance intention influences the actual use continuance of the system. The IS use construct can be defined in many different ways (Burton-Jones and Straub, 2006). Moreover, new factors, such as habit and behavioral expectation, have been proposed as alternatives to use intention (Limayem et al., 2007; Venkatesh, Brown, Maruping, and Bala, 2008). Integrating those findings into the model and empirically testing it would make a further research contribution in this vital research stream.

CHAPTER 2

THE TECHNOLOGY USE MODEL (TUM): THEORETICAL DEVELOPMENT AND EMPIRICAL TEST

2.1 Abstract

Studies based on Technology Acceptance Model (TAM: Davis, 1989) concern the early adoption of a new technology with limited usage of the user. Recently, post-adoption usage becomes a new focus because prior studies have shown that TAM constructs are not effective in explaining continued usage. The increased complexity of modern systems and development methodologies demand a solution in diagnosing system use after an extended period of system implementation.

However, such a comprehensive model which depicts the overall picture for how users utilize an established information system is still lacking. This model should contain relevant factors which contribute to the actual system use and explain how members of an organization keep using a system in an "equilibrium" state. In this paper, the author integrates the work of Bhattacherjee (2001), Burton-Jones and Straub (2006), Limayem et al. (2007), and Venkatesh et al. (2008) and proposes an integrated Technology Use Model (TUM) which depicts the technology utilization phenomenon in an IS use continuance context.

This study collects data regarding various systems using survey methods on typical business professionals to examine the proposed TUM. The empirical results demonstrate the validity of the proposed model. Significant contributions to research and practice for the IS discipline and new research directions are identified and discussed.

2.2 Introduction

Information technology has become an integral part of modern organizations and plays a critical role in providing competitive advantages for the business in today's fierce competitive environment (Carr, 2003; Melville, Kraemer, and Gurbaxani, 2004). Consequently, the way in which members of an organization can smoothly adopt a new technology is a major focus for the MIS discipline (Silva, 2007). Research related to the Technology Acceptance Model (TAM: Davis, 1989) has become part of the IS discipline's theoretical foundation. Most IS researchers recognize its importance (Goodhue, 2007), but some call for new theoretical developments beyond the confinement of TAM (Straub and Burton-Jones, 2007).

TAM was introduced twenty years ago. Technology advancements in the last two decades have raised new issues in the system implementation process (Lucas, Swanson, and Zmud, 2007). Today's information systems become highly integrated with business processes throughout the organization (Keil, Mann, and Rai, 2000). A new generation of system development methodologies, such as agile methodology, emphasizes early system prototype release and frequent user feedback (Fruhling and De Vreede, 2006). Thus, new challenges are most post-adoption (Jasperson, Carter, and Zmud, 2005) and cannot be explained by TAM, which focuses on early adoption stage only.

Bhattacherjee's Post-Acceptance Model of IS Continuance (2001) provided a fresh theoretical foundation on post-adoption research (Limayem, Hirt, and Cheung, 2007). The proposed IS continuance model predicts well on its final dependant variable, IS use continuance intention (Bhattacherjee, 2001). Recently, the assumed relationship between intention and action is challenged and several related constructs and how they predict the final IS use have been proposed (Venkatesh, Brown, Maruping, and Bala, 2008; Limayem et al., 2007). However, an integrated model which presents a comprehensive picture on how users utilize an information system beyond initial system adoption is still lacking. This model should reveal relevant factors which contribute to IS use continuance and its actual use in organization and explain that how members of an organization keep using a system in an "equilibrium" state. In this study, our research objective is to propose and validate such a "Technology Use Model".

2.3 Research on Technology Acceptance

The Technology Acceptance Model (TAM), proposed more than twenty years ago by Davis (1989), is theoretically based on the Theory of Reasoned Action (TRA, Figure 2.1) (Fishbein and Ajzen, 1975) and Theory of Planned

Behavior (TPB, Figure 2.2) (Ajzen, 1991). TRA, which has been accepted and adopted in many disciplines including MIS, consists of a number of inter-related constructs. As seen in Figure 2.1, attitude is defined as “an individual’s positive or negative feelings (evaluative affect) about performing the target behavior” (Fishbein and Ajzen, 1975, p. 216). Subjective norm refers to “the person’s perception that most people who are important to him think he should or should not perform the behavior in question” (Fishbein and Ajzen, 1975, p. 302). Beliefs and evaluations are the individual’s salient beliefs about consequences of performing the behavior multiplied by the evaluation of those consequences (Davis, Bagozzi, and Warshaw, 1989). Normative beliefs are perceived expectations of specific referent individuals or groups and should be multiplied by motivation to comply with these expectations to determine subjective norm (Davis et al., 1989).

The TPB (Ajzen, 1991) extended the TRA model by adding two new constructs: “control beliefs and perceived facilitation” and “perceived behavior control” as can be seen in Figure 2.2.

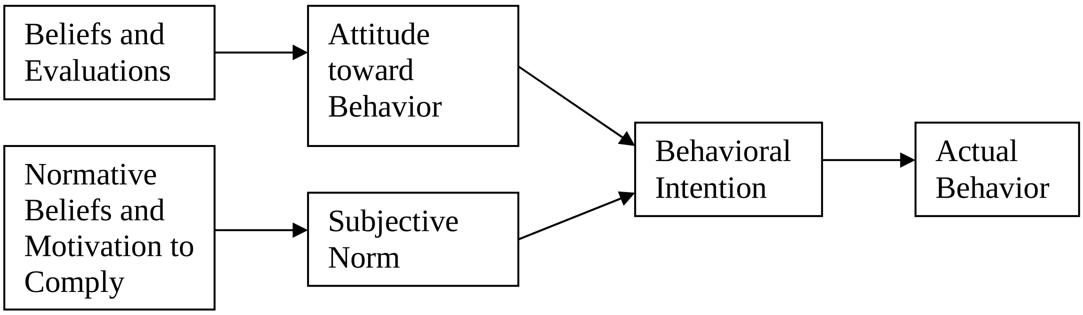

Figure 2.1: Theory of Reasoned Action (TRA: Fishbein and Ajzen, 1975)

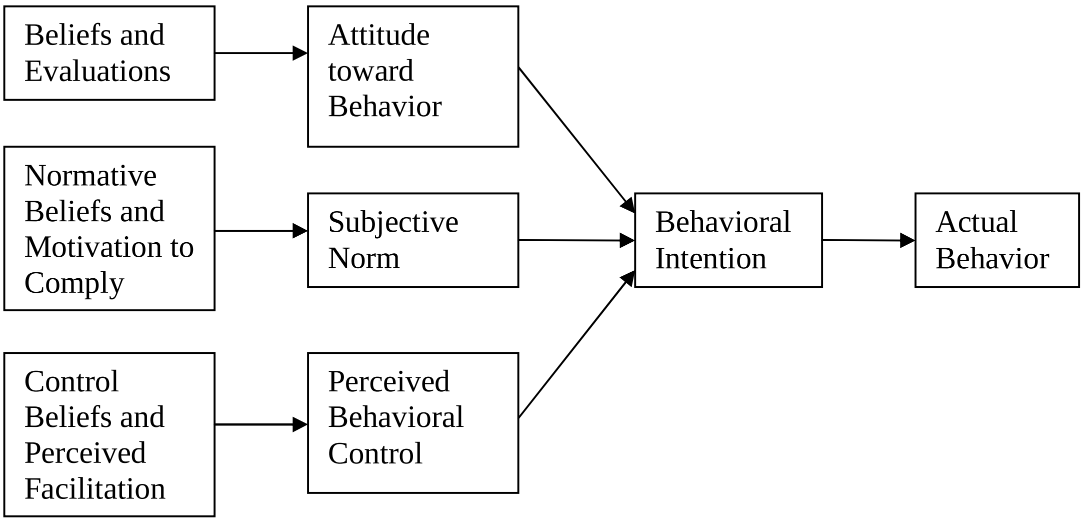

Figure 2.2: Theory of Planned Behavior (TPB: Ajzen, 1991)

In the Technology Acceptance Model (TAM, Figure 2.3), Davis (1989) proposed and empirically showed that Perceived Usefulness and Perceived Ease of Use are the most critical factors in the technology adoption process. The model can be seen as a special case of TRA, in which the perceived usefulness and perceived ease of use are both beliefs and evaluation, leading to attitude, which in turn leads to intention, and finally actual behavior.

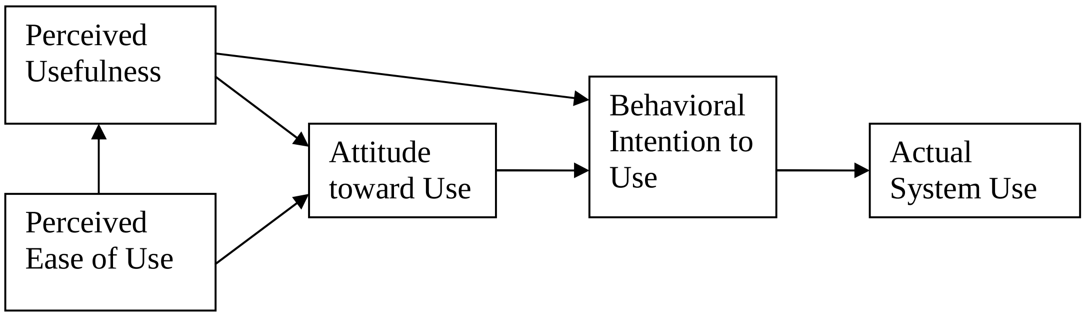

Figure 2.3: Technology Acceptance Model (TAM: Davis, 1989)

The technology acceptance research spawned by TAM has become the most influential research stream for the IS discipline (Hirschheim, 2007). Researchers have attempted to integrate TAM with other related research streams, such as innovation adoption (Rogers 1983; Moore and Benbasat 1991), motivation model, and social recognition model (Venkatesh, Morris, Davis, and Davis, 2003). The Perceived Characteristics of Innovation (PCI) (Moore and Benbasat, 1991) recognizes the similarity of innovation diffusion model (Rogers, 1983) and TAM, and successfully consolidate them into a more parsimonious set of factors.

Venkatesh and Davis (2000) have attempted to integrate TAM, PCI and TRA by proposing an Extended Technology Acceptance Model (known as TAM2, Figure 2.4). This line of research is culminated by the Unified Theory of

Acceptance and Use of Technology (UTAUT, Figure 2.5) developed by Venkatesh et al. (2003) which integrated eight theoretical models from technology acceptance, motivation theory (Vallerand, 1997), and social cognition theory (Compeau and Higgins, 1995). Figure 2.6 summarized the relationships between the models mentioned above.

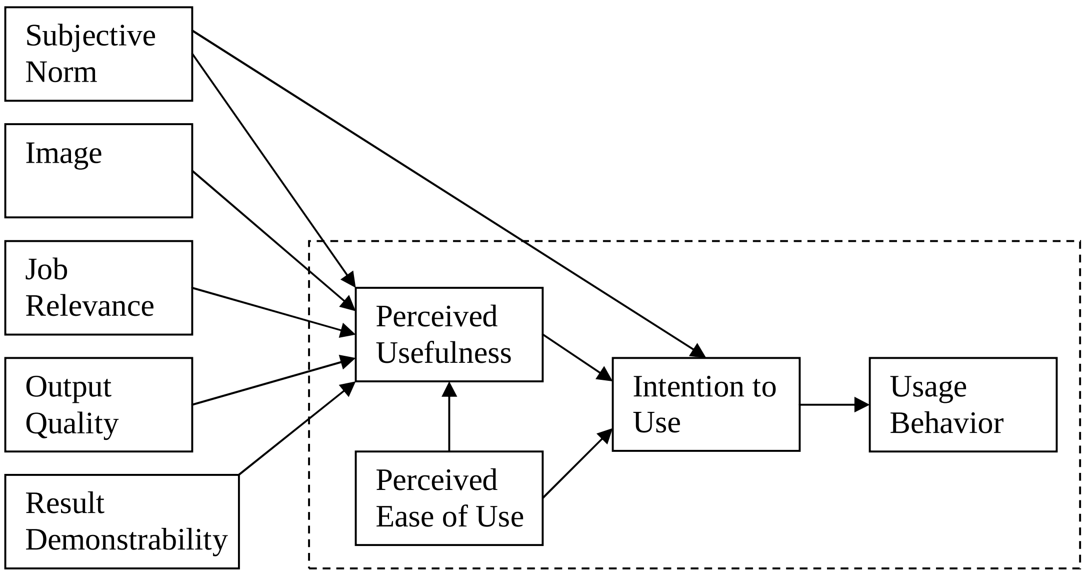

Figure 2.4: Extended Technology Acceptance Model
(TAM2: Venkatesh and Davis, 2000)

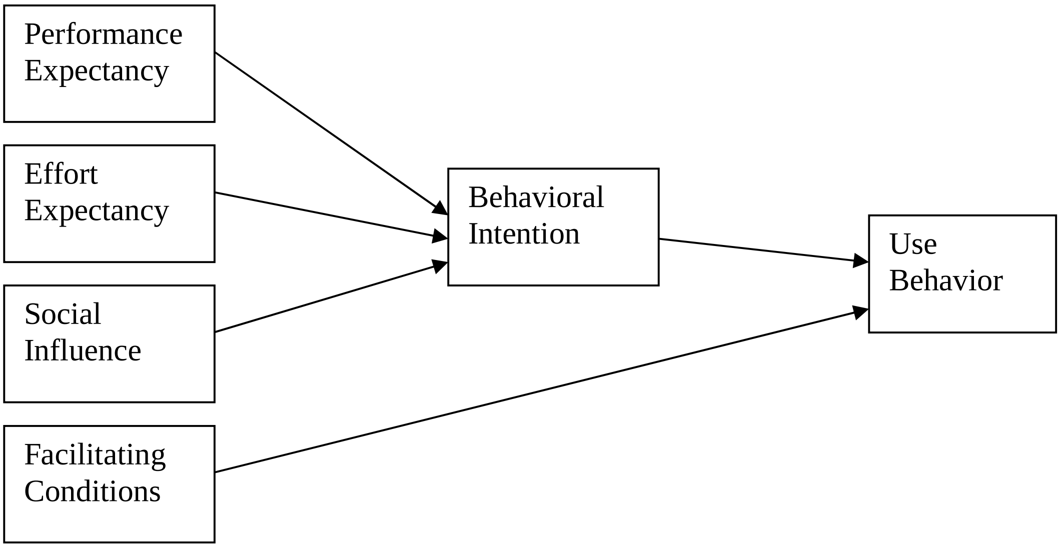

Figure 2.5: Unified Theory of Acceptance and Use of Technology (UTAUT, Venkatesh et al., 2003)

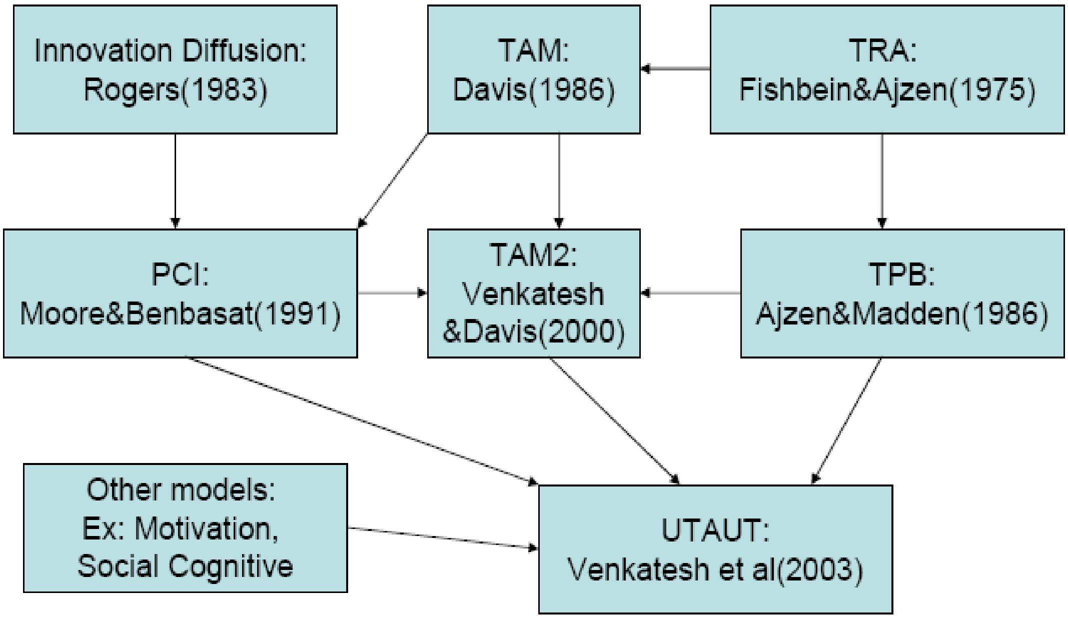

Figure 2.6: The Progression of Technology Acceptance Research

2.4 What Happened When Users Keep Using the System?

Bhattacherjee's IS Continuance Model (2001, Figure 2.7) establishes a solid foundation in the IS discipline for this work. The underlying theory is Expectation-Disconfirmation Theory (EDT: Oliver, 1980) which has been applied widely in various product repurchase and service continuance contexts (Bhattacherjee, 2001). Consumers possess expectations toward the product or service before they actually purchase. After the purchase and consumption, consumers assess the perceived performance versus original expectation and form a confirmation (if performance is better than expectation) or disconfirmation (if performance can not meet expectation) toward the product or service consumed. Next, the assessment result (confirmation or disconfirmation) leads to satisfaction (or disconfirmation) and then to repurchase intention.

Based on EDT, the model posits that users' satisfaction influences their intention to continually use the system, and the confirmation construct which is based on the gap between user's expectation and actual use experience decides satisfaction. The users' confirmation toward the system also lead to its "usefulness" they perceived. If the use experience is positive comparing to what they expected, users consider the system more useful than before. Conversely, if users feel disappointed and frustrated after usage, they will not evaluate the system as highly useful. The perceived usefulness would then lead to continual intention (see Figure 2.7).

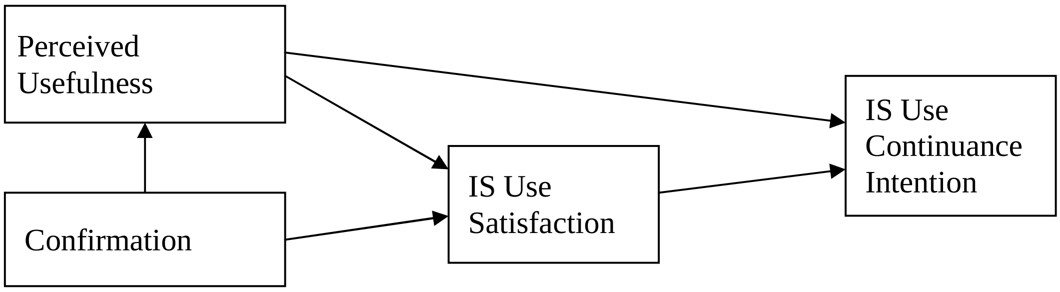

Figure 2.7: Post-acceptance Model of IS Continuance
(Bhattacherjee, 2001)

The “usefulness” of a system, according to the classical definition by Davis (1989), pertains to the degree that the system can help improve users’ job performance. However, in a use continuance context, it is argued that system users will recognize that the system can do more than just getting things done. Au, Ngai, and Cheng (2008) point out that using a system can induce satisfaction by fulfilling three types of fundamental human needs: existence, relatedness, and growth (Alderfer, 1969). For organization employees, existence need is the urge to get the job done efficiently and effectively, relatedness need refers to the hope to communicate and be accepted by others, and growth need pertains to the motivation to fully realize their potential. Thus, after extensively using the system, users will develop a new type of “usefulness” which contains above-mentioned three components. This study names it “perceived needs fulfillment.”

2.5 The System Use and Its Predictors: Recent Developments

IS use has been an important construct in several IS research streams (Burton-Jones and Gallivan, 2007). It can be utilized as an independent variable to examine the impact of IS use (Goodhue, 1995) or as a dependent variable to gauge the degree of utilization of the IS (Venkatesh et al., 2003). Thus, the definition of IS use varies. It can be based on a simple binary measure (use or no-use) or a comprehensive one involving the IS, the user, and the task (Burton-Jones and Straub, 2006). Many researchers have indicated that the IS use should have a richer conceptualization (Jasperson et al., 2005; Burton-Jones and Gallivan, 2007; Doll and Torkzadeh, 1998).

Burton-Jones and Straub (2006) suggest that a two-stage approach should be adopted to develop the IS use construct for a specific study. In the definition stage, clear assumptions should be listed and proper definition of IS use be given. In the selection stage, the IS use structure which comes from the IS, the user, and the task of the research question should be operationalized and justified.

Venkatesh et al. (2008) recognized the importance and complexity of IS use and proposed that the three most common IS use conceptualizations are duration, frequency, and intensity of system use. According to this, one should follow the method suggested by Burton-Jones and Straub (2006) and operationalized the system use as a formative construct (Petter, Straub, and

Rai, 2007) which contains three components: duration, intensity, and frequency of use.

Venkatesh et al. (2008) indicated that the two common constructs in technology acceptance research models, i.e. behavioral intention and facilitating condition, have some limitations in predicting the behavior of IS use. Intention does not include external factors and can not cope with uncertainty in the adoption process. Facilitating condition addresses some external variables but still can not handle cases of incomplete information (Sheeran, Trafimow, and Armitage, 2003). In the Unified Theory of Acceptance and Use of Technology (UTAUT) proposed by Venkatesh et al. (2003), facilitating condition directly affects the final IS usage behavior.

Behavior expectation, however, is a better predictor of behavior for conditions under above-mentioned limitations (Warshaw and Davis, 1985). Mechanisms such as mental simulation and extrapolation tactics can explain how the behavioral expectation can take various outcomes and their probabilities into consideration. Thus, behavior expectation reflects a more precise possibility of acting than behavioral intentions and facilitating condition (Venkatesh et al., 2008).

Habit is another important predictor of IS usage behavior and its predicting powers are theoretically grounded in a continuance context (Limayem et al., 2007). Several studies regarding IS post-adoption phenomenon reach a similar conclusion that the typical antecedents of intention on technology acceptance explain much less variance in intention to use on IS post-adoption users (Taylor and Todd, 1995; Agarwal and Prasad, 1997; Karahanna, Straub, and Chervany, 1999). Similar to the routinization and infusion effects which occurred in the final stages of IT implementation model (Saga and Zmud, 1994), IS users tend to automate IS usage behavior through learning after using the system for a certain period of time: i.e., the system use becomes a habit to the IS users.

2.6 Research Model and Methodology

2.6.1 Research Model

To develop an IS use continuance model, all four predictors discussed earlier (behavioral intention, behavioral expectation, facilitating conditions, and habit) all seem to be relevant. However, it is argued that habit and behavioral expectation are mutually exclusive. The existence of habit assumes the user performs behavior in an automatic way and without cognitive attention (Verplanken, Aarts, Van Knippenberg, and Van Knippenberg, 1994). But behavioral expectation regards calculating probability of performing a behavior based on his or her cognitive appraisal of related determinants (Warshaw and Davis, 1984). Thus, given the theoretical context of this study, habit can be expected to become dominant after an extended period of system use. According to James (1890), “habit simplifies the movements required to achieve a given result, makes them more accurate and diminishes fatigue.”

The definition of behavioral intention is: “the degree to which a person has formulated conscious plans to perform or not perform some specified future behavior” (Warshaw and Davis, 1985). Behavioral intention, which is based on the user’s internal motivation, can be a valid predictor but its predictive power may be weakened by the existence of habit (Limayem et al., 2007). The last predictor, facilitating conditions, refers to “the degree to which an individual believes that an organizational and technical infrastructure exists to support of use of the system” (Venkatesh et al., 2003). It is similar to perceived behavioral control (Ajzen, 1991), facilitating conditions (Thompson and Higgins, 1991), and compatibility (Moore and Benbasat, 1991). It defines the context of the focus system and thus can impact the IS use habit because stable context is one of the antecedents of IS use habit (Limayem et al., 2007).

Based on the above discussion, the research model for the current study is presented in Figure 2.8. The model, referred to as the Technology Use Model (TUM), attempts to capture major factors that contribute to the use and reuse of an information system after the initial adoption. The left part of the model is based on Bhattacherjee’s IS continuance model (2001) but with an enhanced “usefulness” construct, i.e., perceived needs fulfillment, as discussed previously.

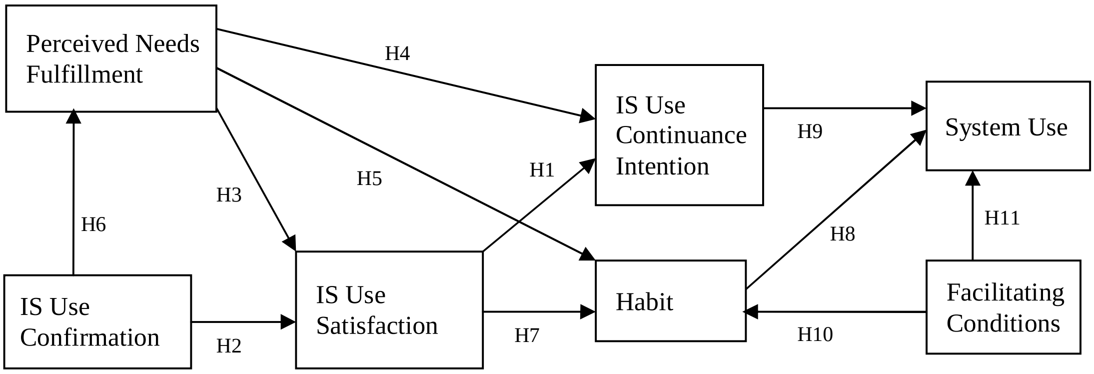

Figure 2.8: Proposed Technology Use Model

2.6.2 Hypotheses

Satisfaction induced by performing a behavior will increase the intention to repeat that behavior. In prior studies, both EDT (Oliver, 1980) and IS Success Model (DeLone and McLean, 2003) incorporate a relationship in which user satisfaction is the antecedent of intention to use. Briggs, Reinig, and De Vreede (2008) also clearly indicate the central role of satisfaction on predicting future system use intention. Thus,

H1: Users' level of satisfaction with IS use is positively associated with their IS use continuance intention.

Confirmation (or disconfirmation) is a critical construct in EDT (Oliver, 1980). It represents the difference between users' original expectation and actual experience. One of the fundamental relationships in EDT (Oliver, 1980) states that the confirmation (or disconfirmation) construct is a predictor of users' satisfaction. Thus,

H2: Users' extent of confirmation is positively associated with their satisfaction with IS use.

Bhattacherjee's IS Continuance Model (2001) demonstrated the relationships of usefulness-satisfaction and usefulness-intention. The author expanded the usefulness concept but the nature of the construct (usefulness of the system) does not change. Therefore, both relationships are still effective in this model. Thus,

H3: Users' perceived needs fulfillment of IS use is positively associated with their satisfaction with IS use.

H4: Users' perceived needs fulfillment of IS use is positively associated with their IS use continuance intention.

Although nonexistent in the Limayem et al. (2007) model, it is argued that there will be a usefulness-habit link which is similar to H4 but in a subconscious way. The habit is a kind of mindset under which users perform the behavior automatically (Orbell, Blair, Sherlock, and Connor, 2001). The original relationship from usefulness to habit is through satisfaction that the users feel. However, after habit has been well established based on extended usage, the users automatically and subconsciously link usefulness and habit directly. Therefore,

H5: Users' perceived needs fulfillment of IS use is positively associated with their IS use habit.

According to Cognitive Dissonance Theory (CDT: Festinger, 1957), users' confirmation toward the system will be adjusted in relation to his or her perception of the system usefulness to avoid cognitive dissonance. In other words, when users' usage experiences exceed their expectations, they will feel that the system is more useful than they originally thought. Thus,

H6: Users' extent of confirmation is positively associated with their perceived needs fulfillment of IS use.

The satisfaction measure is now commonly regarded as an affective measure that reflects the emotional state of the respondents, and not a combination of system features or performance measures (Briggs et al., 2008). Satisfaction caused by a behavior is a key condition for habit development toward that behavior, because satisfaction increases people's tendencies to perform the behavior repeatedly (Aarts, Verplanken, and Van Knippenberg, 1998). Therefore,

H7: Users' satisfaction with IS use is positively associated with their IS use habit.

Once IS users form habits on system usage, the mental efforts and conscious attention regarding the behavior are reduced and the behavior is performed automatically (Orbell et al., 2001). Thus,

H8: Users' IS use habit is positively associated with their system use.

Intention to perform a behavior is a classical predictor to that behavior in many theories and models, such as TRA (Fishbein and Ajzen, 1975), TPB (Ajzen, 1991), and TAM (Davis, 1989). Thus,

H9: Users' IS use continuance intention is positively associated with their system use.

A resourceful and supportive environment can reinforce the repetitive system use and resulting usage habit. Moreover, facilitating condition is treated as a direct predictor of IS usage in the model of UTAUT (Venkatesh et al., 2003) when behavioral expectation is not present. Thus,

H10: Facilitating condition of the system is positively associated with IS use habit.

H11: Facilitating condition of the system is positively associated with system use.

2.6.3 Data Collection

Data were collected by paper-based surveys from graduate students (some sections were mixed with senior undergraduate students) in business courses at a large public university in the South. Subjects had been requested to answer the questionnaires based on their experience of using a self-identified system. In order to focus on target population – business professionals who utilize systems for their daily operations, it is recommended that the respondents consider following criteria when selecting the focused system: (1)

important to their job; (2) supported by IT department of their organization; (3) delivering information to users on a regular basis; and (4) choosing only one module if it is an ERP system. Emphasizing above criteria can improve the quality of the data and clarify the definition of the systems incorporated in this study.

2.6.4 Construct Development and Pilot Test

Seven main constructs are measured in the research model: IS use confirmation, perceived needs fulfillment, IS use satisfaction, IS use continuance intention, habit, facilitating conditions, and system use. All constructs and their items are adapted from previous studies and detailed information is listed in the appendix. Among the seven constructs, perceived needs fulfillment and system use are formative constructs (Petter et al., 2007). System use is formed by three types of usage behavior: duration, intensity (or depth), and frequency. All three usage measures are collected in a self-report fashion in the questionnaire. Perceived needs fulfillment, however, is a second-order formative construct which is assembled by several reflective constructs: perceived efficiency, perceived effectiveness, relatedness fulfillment, and self-development fulfillment. These four reflective constructs and the other five main constructs mentioned earlier are all measured by the seven-point Likert scale anchored from “Strongly Agree” to “Strongly Disagree.”

IS use confirmation items are from Bhatacherjee (2001). It was measured by statements which involves "… better than expected." The perceived needs fulfillment items are adapted from Davis (1989) and Au et al. (2008). To measure the IS user satisfaction as an affective construct, we used items such as "I feel delighted …," "I am satisfied …," and "I am pleased …" which are adapted from Au et al. (2008), Briggs et al. (2008), and Bhattacherjee (2001). The items of IS use continuance intention are drawn from the work of Bhattacherjee (2001). Venkatesh et al. (2008) also uses intention construct items but they are not designed for use continuance context. Items for the habit construct are adapted from Limayem et al. (2007). Facilitating conditions items are from Venkatesh et al. (2008). The author conducted a pilot test with faculty members and doctoral students to ensure content validity on these measurement scales. A number of minor refinements were made based on feedback and suggestions.

2.7 Data Analysis

2.7.1 Data Analysis Methodology

Both the Structural Equation Modeling (SEM) and Partial Least Square (PLS, Fornell and Bookstein, 1982) techniques can handle multi-level and inter-related relationships simultaneously among constructs. However, PLS possesses two additional advantages over SEM: (1) PLS does not require normality and independence assumptions, and (2) PLS is capable of dealing with formative constructs (Chin and Newsted, 1999). Thus, we use the PLS technique to conduct data analysis for this research. SmartPLS 2.0 (Ringle, Wende, and Will, 2005) is the software package we used to conduct data analysis. According to Lee, Kozar, and Larson (2003), the average sample size of major TAM publications from 1989 to 2003 is around 200.

2.7.2 Data Screening, Data Characteristics, and Control Variable Analysis

The raw dataset contains 358 surveys. The author screened the dataset and removed 47 samples. Major reasons for eliminating samples include: (1) too many blanks; (2) monotone or patterned responses; and (3) answers were based on a computer application, not an information system. Next, univariate outliers (Hair, Black, Babin, Anderson, and Tatham, 2006) were examined. Several outlier figures were found on the organization size, one of the control variables. Since later we found out that organization size is not a significant control variable, the outliers are not relevant to research results. Thus, there are 311 samples in the final dataset after data screening process.

The information regarding demographic and control variables is summarized in Table 2.1. The respondent's data characteristics fit the profile of typical white-collar knowledge workers who utilize systems to handle daily jobs in various business settings.

Table 2.1 Data Characteristics

Demographic Variable	Category	Count	Percentage
Age	20 and below	4	1.3
	21-30	178	57.2
	31-40	90	28.9
	41-50	31	10.0
	51-60	6	1.9
Education	High School Degree	8	2.6
	Associate Degree	6	1.9
	Bachelor Degree	194	62.4
	Master Degree	95	30.5
	Doctorate Degree	4	1.3
Gender	Male	188	60.5
	Female	120	38.6
Organization Industry	Manufacturing	46	14.8
	Banking/Insurance/Financial Service	55	17.7
	Hotel/Entertainment/Service Industry	14	4.5
	Construction/Architecture/Engineering	27	8.7
	IT/Telecommunications	20	6.4
	Consulting/Business Service	13	4.2
	Health Care	20	6.4
	Government/Military	23	7.4
	Education	13	4.2
	Other	78	25.1
Job Title	Employee	150	48.2
	Manager	60	19.3
	Executive	19	6.1
	Professional	13	4.2
Organization Size	Range from 2 to 300,000; Mean 11,796 (employees)		
Tenure with Organization	Range from 0.1 to 30; Mean 4.53 (years)		
Tenure with Current Position	Range from 0.1 to 25; Mean 2.67 (years)		
System Adoption Time	Range from 1 to 242; Mean 37; Mode 24 (months)		

Other than demographic variables, several factors were added as control variables which are alternative causes to explain variances in the endogenous model constructs. Therefore, eleven control variables have been examined in total: age, education, gender, organization industry, organization size, job title, tenure with organization, tenure with current position, voluntariness, system adoption time, and system importance. It was discovered that only system importance is a significant control variable to two endogenous variables: perceived needs fulfillment and system use.

2.7.3 Common Method Bias Analysis

Common method bias (CMB) will cause inflation on model relationship coefficients if the research design dictates that the data for independent and dependent variables is obtained from a common source and in a similar context (Podsakoff and Organ, 1986). However, CMB is not a serious problem for IS studies (Malhotra, Kim, and Patil, 2006) for two reasons. First, IS research usually involves more “concrete” type of constructs such as satisfaction and performance. Such concrete measures are more robust to CMB than more abstract measures which are frequently adopted in other social science disciplines (Cote and Buckley, 1987). Second, the target of IS studies usually is an information system or a technology, and the respondents are not likely to be emotionally associated with such IT artifacts. Thus, Malhotra et al. (2006) empirically examined 216 past IS studies and found that most conclusions on model relationships hold after controlling for CMV and the correlations had been inflated only by a very limited degree (less than 0.1).

Nevertheless, it is still necessary to take measures recommended in previous literature to control the CMB. Podsakoff, MacKenzie, Lee, and Podsakoff (2003) suggest various ways to separate the related constructs items in the questionnaire. Construct items were carefully arranged into several groups and the constructs in each group are not directly linked in the research model (proximal separation). Demographic items which use different forms of measurement are located between the item groups (psychological and methodological separations). Moreover, respondents were informed that the survey is anonymous (reassuring respondent anonymity) and that there is no right or wrong answers to the questions (minimizing evaluation apprehension) (Podsakoff et al., 2003).

In the data analysis stage, approaches suggested in previous literature were followed to examine the incurred CMB in this study. Podsakoff et al. (2003) recommended Harman's one factor test to check if there is a universal factor which relates to most items. Liang, Saraf, Hu, and Xue (2007) also demonstrated a new technique to inspect CMB in PLS structural models. We can conclude that CMB is not a concern to the findings of this study because both diagnosing approaches mentioned above were passed.

2.7.4 Validities of Measurement Scales

Based on Diamantopoulos and Winklhofer (2001), the multicollinearity of construct items was examined. Two satisfaction items (Satisf2 and Satisf4) were dropped because their variance inflation factors (VIF) exceed ten. Next, both convergent and discriminant validity were checked by inspecting the loading of individual item to its corresponding construct. Details of the loading coefficients are summarized in Table 2.2. Checking convergent validity is not necessary for formative constructs because each item in a formative construct represents different component (Petter et al., 2007). Thus, perceived needs fulfillment and system use are not included in Table 2.2.

Each item correlates to its latent variable with a high coefficient (larger than 0.7) showing good convergent validity (Gefen and Straub, 2005). No items from other constructs loaded higher than a specific construct's items, indicating high discriminant validity. After removing two items (FaciCond3 and FaciCond4) of facilitating conditions for low loadings and re-performing the analysis, all manifest variables in the model satisfied convergent and discriminant validity checks (Table 2.2).

This study also attempted to ensure validities by examining the composite reliability and average variance extracted (AVE). Table 2.3 presented the correlations between main constructs and the diagonal elements (bolded in the table) are square root of AVE scores. The AVE square root represents the correlation between the construct and its own items, so it must be highest comparing to other correlation coefficients to show satisfactory discriminant validity. All constructs satisfied this requirement. Moreover, the composite reliability should be higher than 0.7 to indicate good internal consistency (Hair et al., 2006). Similarly, Fornell and Larcker (1981) stated that AVE should be higher than 0.5. From Table 2.3, it was found that the composite reliability and AVE of all major constructs in the model are much higher than the standard value presented above.

Table 2.2 Correlations of Individual items to Constructs

	INT	CFM	EFC	EFI	FC	HAB	RF	SAT	SF
CUseInten1	**0.941**	0.685	0.577	0.635	0.391	0.584	0.503	0.744	0.517
CUseInten2	**0.929**	0.685	0.530	0.597	0.354	0.598	0.479	0.746	0.516
CUseInten3	**0.796**	0.413	0.371	0.443	0.232	0.377	0.264	0.533	0.341
Confirm1	0.649	**0.903**	0.595	0.669	0.408	0.633	0.491	0.717	0.539
Confirm2	0.615	**0.904**	0.529	0.613	0.336	0.541	0.398	0.698	0.465
Confirm3	0.556	**0.861**	0.509	0.570	0.388	0.517	0.403	0.622	0.447
Effecti2	0.447	0.495	**0.891**	0.741	0.381	0.587	0.485	0.452	0.436
Effecti3	0.512	0.572	**0.901**	0.686	0.361	0.569	0.576	0.522	0.574
Effecti4	0.569	0.601	**0.926**	0.823	0.384	0.589	0.517	0.557	0.511
Efficien1	0.612	0.644	0.759	**0.923**	0.421	0.622	0.459	0.545	0.445
Efficien2	0.572	0.641	0.782	**0.914**	0.496	0.652	0.436	0.570	0.443
Efficien4	0.584	0.652	0.768	**0.945**	0.471	0.649	0.474	0.575	0.467
FaciCond1	0.366	0.420	0.387	0.486	**0.944**	0.520	0.233	0.344	0.224
FaciCond2	0.345	0.388	0.399	0.463	**0.955**	0.533	0.255	0.337	0.243
Habit1	0.524	0.562	0.551	0.620	0.543	**0.935**	0.333	0.473	0.278
Habit2	0.590	0.604	0.580	0.623	0.545	**0.945**	0.407	0.519	0.366
Habit3	0.531	0.595	0.651	0.673	0.443	**0.885**	0.424	0.511	0.390
RelatNF1	0.463	0.501	0.576	0.472	0.315	0.451	**0.909**	0.470	0.742
RelatNF2	0.384	0.378	0.494	0.423	0.180	0.313	**0.873**	0.393	0.678
RelatNF3	0.459	0.440	0.505	0.443	0.201	0.375	**0.938**	0.443	0.746
Satisf1	0.683	0.714	0.515	0.545	0.295	0.485	0.442	**0.936**	0.474
Satisf3	0.763	0.750	0.562	0.603	0.352	0.542	0.457	**0.963**	0.509
Satisf5	0.699	0.688	0.503	0.533	0.341	0.488	0.435	**0.915**	0.519
Satisf6	0.742	0.730	0.541	0.603	0.361	0.527	0.476	**0.952**	0.520
SelfDNF1	0.497	0.506	0.542	0.460	0.244	0.360	0.794	0.502	**0.907**
SelfDNF2	0.471	0.495	0.485	0.416	0.214	0.335	0.723	0.475	**0.939**
SelfDNF3	0.485	0.513	0.522	0.476	0.227	0.339	0.690	0.512	**0.928**

INT: Use Continuance Intention　CFM: IS Use Confirmation　EFC: Perceived Effectiveness
EFI: Perceived Efficiency　FC: Facilitating Conditions　HAB: Habit
RNF: Relatedness Fulfillment　SAT: IS User Satisfaction　SF: Self-Development Fulfillment

Table 2.3 Correlation Matrix and Composite Reliability for Principal Constructs

Construct	Composite Reliability	Mean	Standard Deviation	INT	CFM	FC	HAB	EFC	EFI	RF	SAT	SF
Use Continuance Intention (INT)	0.920	4.540	1.893	**0.89**								
IS Use Confirmation (CFM)	0.919	4.423	1.369	0.68	**0.89**							
Facilitating Conditions (FC)	0.948	5.460	1.324	0.37	0.42	**0.95**						
Habit (HAB)	0.944	4.950	1.581	0.60	0.64	0.56	**0.92**					
Perceived Effectiveness (EFC)	0.932	4.890	1.536	0.56	0.61	0.41	0.64	**0.91**				
Perceived Efficiency (EFI)	0.949	5.170	1.495	0.64	0.70	0.50	0.69	0.83	**0.93**			
Relatedness Fulfillment (RF)	0.933	3.840	1.732	0.48	0.49	0.26	0.42	0.58	0.49	**0.91**		
IS User Satisfaction (SAT)	0.969	4.300	1.589	0.77	0.77	0.36	0.54	0.56	0.61	0.48	**0.94**	
Self-Development Fulfillment (SF)	0.947	3.980	1.784	0.52	0.55	0.25	0.37	0.56	0.49	0.80	0.54	**0.93**

Diagonal elements (Bolded) in the correlation matrix are square root of AVE

2.8 Research Results

2.8.1 Structural Model

The path coefficients and significance outcomes of the PLS structural model (or inner model) are presented in Figure 2.9. To assess the p-value, this study uses 300 bootstrapping runs to calculate t-value. Almost all relationships are highly significant ($p<0.01$). The two exceptions are IS use continuance intention to system use (Insignificant) and satisfaction to habit (Significant at p<0.05). The values of R^2 are quite high: the range is from 0.549 (habit) to 0.632 (IS use continuance intention) except system use (0.248).

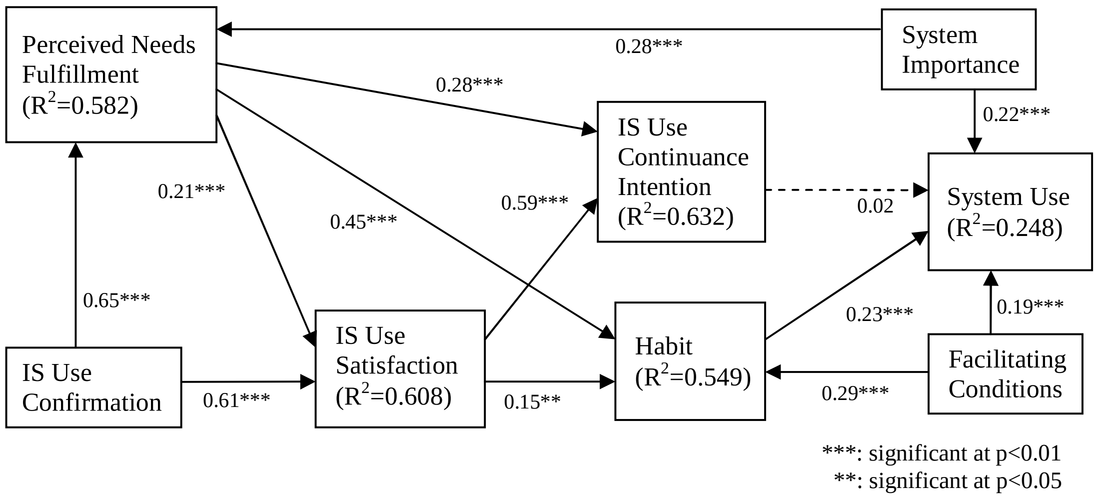

Figure 2.9: PLS Structural Model of Proposed TUM

However, the IS use continuance intention is not significantly related to system use. Since the IS use continuance intention cannot predict the final system usage, it was decided that it should be removed. In the trimmed Technology Use Model (TUM: Figure 2.10), the R^2 for habit and system use increased to 0.553 (from 0.549) and 0.250 (from 0.248) respectively and the rest of the model remains the same.

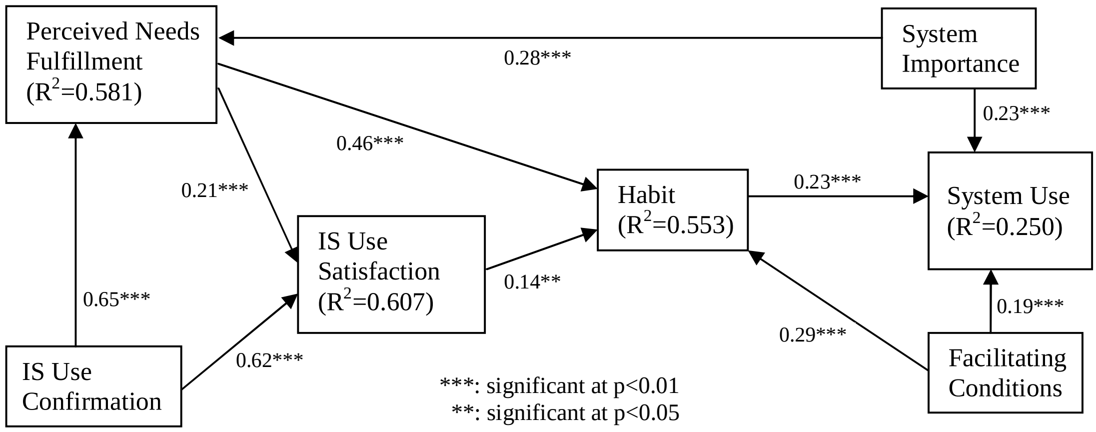

Figure 2.10: Trimmed Model (Finalized Technology Use Model)

2.8.2 Hypotheses Testing

For the original model (Figure 2.9), all hypotheses are supported by structural model output with the only exception of H9. Moreover, the removal of IS use continuance intention makes H1 and H4 not meaningful for the model. The hypotheses testing results are summarized in Table 2.4.

Table 2.4 Summary of Hypothesis Testing

Hypothesis	Relationship	Result
H1*	IS Use Satisfaction - Use Continuance Intention	Supported
H2	IS Use Confirmation – IS User Satisfaction	Supported
H3	Perceived Needs Fulfillment – Satisfaction	Supported
H4*	Perceived Needs Fulfillment - Use Continuance Intention	Supported
H5	Perceived Needs Fulfillment – Habit	Supported
H6	IS Use Confirmation - Perceived Needs Fulfillment	Supported
H7	IS User Satisfaction – Habit	Supported
H8	Habit – System Use	Supported
H9*	Use Continuance Intention – System Use	Not Supported
H10	Facilitating Conditions – Habit	Supported
H11	Facilitating Conditions - System Use	Supported

* Not in the final Technology Use Model

2.9 Discussion and Conclusion

2.9.1 Discussion

The proposed Technology Use Model (TUM) reflects an equilibrium state of usage by users of an existing information system or technology. IS use confirmation, the gap between the actual system value perceived by users from prior use experience and how the system should perform in user's mind, links to both user's satisfaction and beliefs regarding the system's capabilities in fulfilling user's needs (perceived needs fulfillment). The capability belief also leads to user's satisfaction. Habit, in turn, is decided by both perceived needs fulfillment and satisfaction. The final dependent variable, system use, can be predicted by habit and facilitating conditions, an environmental factor.

In TUM, the system use can be predicted by habit, facilitating conditions, and system importance. The variance explained is 25%, relatively low compared to other dependent variables in the model. However, the system use construct is a formative combination of three different type of usage (duration, frequency, and depth) and the research design covers all types of systems, users, and tasks. Therefore, 25% is a promising result considering many other possible influencing sources on its variations. For example, important determinants of system use, such as individual and organizational information requirements being supported by the system, are not included in the model.

These results also reveal that habit plays a prominent role in TUM. After an extended period of use, explicit cognitive estimation on continuance intention will no longer be a reliable predictor of actual system use. Instead, the extent of usage behavior automation without conscious thought takes over and becomes a significant predictor of system use. In TUM, three factors lead to the habit construct: perceived needs fulfillment (coefficient 0.46), IS use satisfaction (0.14), and facilitating conditions (0.29). The strongest relationship is from needs fulfillment, which is the degree that users believe that the system can help fulfilling their needs, or a more universal type of "usefulness." Thus, the more the system is useful to the users, the higher the possibility that the users will develop habit to use the system. Satisfaction and context factor (facilitating condition) are also shown to be important antecedents to habit (Limayem et al., 2007). The high R^2 of habit (55%) demonstrated that this model includes factors that are instrumental in forming users' habit, which is certainly central to the technology use phenomenon.

The remaining endogenous variables also have high R^2: 58% for perceived needs fulfillment and 61% for IS use satisfaction. Confirmation is the main explaining factor for both constructs. Such empirical result reinforces the validity of EDT (Oliver, 1980).

2.9.2 Implications for Research and Practice

Researchers have shown that TAM constructs are not suitable in explaining post-adoption usage behavior (Taylor and Todd, 1995; Karahanna et al., 1999). However, a comprehensive model which depicts the overall picture of how users utilize an information system is still lacking. This model should contain relevant factors which contribute to the actual system use and explain how members of an organization keep using a system in an "equilibrium" state. Our Technology Use Model integrates the work of Bhattacherjee (2001), Burton-Jones and Straub (2006), Limayem et al. (2007), and Venkatesh et al. (2008), and successfully depicts the technology utilization phenomenon in an IS use continuance context.

One major research limitation for TAM studies is the generalizability issue (Lee et al., 2003). Since the TAM examines the initial adoption of a technology, researchers have to locate such newly-introduced systems. Most of the empirical settings in TAM papers, therefore, regard only one system in one organization. Thus, one must cautiously apply the findings of such single-source studies on other scenarios. This study, however, adopts IS use continuance context and collects data from various systems, users, and organizations. Therefore, the research results in this study can be applied to more general circumstances.

This research also has implications for practice. The important role of habit in TUM means that attempting to recognize it and measure it may be a good management practice in order to ensure use continuance. At the same time, providing a supportive environment and ensuring the system's relevance to user's job also improves the system usage. If habit is not present, efforts to measure the perceived needs fulfillment, satisfaction, and confirmation should provide helpful diagnostic information.

2.9.3 Limitations and Future Studies

This study used students as the research population and some researchers have concerns regarding the generalizability of such arrangements (Agarwal and Prasad, 1997). However, our surveys regard IS use experience in a business environment, thus all respondents to our survey are students who are also experienced business professionals. The demographic data in Table 2.1 also show that the survey subjects are affiliated with various organizations and industries, not just the university. Moreover, from earlier discussion it was already indicated that the research design of this research enhances the generalizability of the research findings. Thus, the generalizability of the research results is not compromised by using students from an educational institution as the research population.

This research is conducted on information systems in a specific setting – an office environment. Although this setting already contains wide varieties of information systems, there are some research domains that are not confined within an organization, such as E-commerce and social computing. Therefore, it is a limitation and also a possibility for future studies. Further research opportunities include applying the TUM to different research domains on different types of systems or technology. Doing such studies can further enhance the robustness of the model.

CHAPTER 3

UNDERSTANDING INFORMATION SYSTEM SUCCESS: TESTING A THEORETICAL MODEL IN THE CONTEXT OF USE CONTINUANCE

3.1 Abstract

This study extends the efforts of prior research regarding theoretically enhancing the information systems (IS) success model (DeLone and McLean, 1992, 2003). The author examines the IS success literature and several important constructs in the IS success model, namely Information Quality, System Quality, Service Quality and User Satisfaction. Next, an important theoretical extension of technology acceptance literature, IS use continuance model (Bhattacherjee, 2001), is introduced.

Researchers have attempted to integrate the Technology Acceptance Model (TAM: Davis, 1989) and the IS success model (Wixom and Todd, 2005). However, TAM is not compatible with the notion of IS success since first, TAM is narrowly focused on the early adoption stage of the system utilization process; and second, IS success is a phenomenon that requires a more extended period of technology utilization to be realized in the organizations. However, IS continuance model and its underlying theory, expectation-disconfirmation theory (EDT: Oliver, 1980), are theoretically better suited to the IS success context,

and thus can build a sound foundation for the IS success and technology utilization integration which have been advocated by many previous scholars.

This study attempts to integrate the IS success model, the IS use continuance model, and a number of recent developments regarding actual system use and its predictors which are not included in earlier studies. This study empirically validated the model using data collected from 311 business professionals and results strongly support the models and hypotheses. Results have made contributions to and implications for both IS research and IT practice. Limitations and future research directions are also discussed.

3.2 Introduction

The adoption and use of information systems have been studied intensively by IS researchers. Davis (1989) proposed the Technology Acceptance Model (TAM) based on the theory of reasoned actions (Fishbein and Ajzen, 1975). For the twenty years since its introduction, TAM has spawned a large number of studies and has become a major area of research in IS (Hirschheim, 2007). The use of information system, however, does not stop after its initial adoption. The IS Success Model developed and refined by DeLone and McLean (1992, 2003) attempts to identify important factors affecting the eventual success of an IS after system adoption. Another important theoretical advance in this direction was made by Bhattacherjee (2001) in his proposed model of system use continuance.

Research studies related to TAM and IS success have shown that these two areas should and can be integrated (Goodhue, 1988; Melone, 1990; Hartwick and Barki, 1994; Seddon, 1997; Wixom and Todd, 2005). However, it is argued that this integration effort should be made in the context of IS use continuance after the users have accumulated substantial actual usage experience. Elements of the IS success model (DeLone and McLean 1992, 2003), such as the three quality measures, systems use, and satisfaction, all assume an extended period of use has elapsed. On the other hand, constructs included in TAM, such as perceived usefulness, attitude, and intention to use are supposed to be taken after very limited initial use. This temporal incompatibility poses considerable theoretical challenges in integrating the two models. The purpose of this research is to develop an IS success model by integrating IS use continuance model (Bhattacherjee, 2001) and IS success model (DeLone and McLean, 2003) using expectancy-disconfirmation theory (EDT: Oliver, 1980) as the theoretical foundation.

This paper is organized as follows. After introduction, we first briefly review literature related to IS success and its major constructs, namely information and system quality, IT service quality, and user satisfaction. Second, we examine several issues regarding the model integration and propose our research model and hypotheses. Third, the details of the model validation methodology and process are presented. Finally, the contribution of this study to both academia and practitioners is discussed, and the limitation and future directions of this research are presented.

3.3 Research on Information Systems Success

The original information systems success model (Figure 3.1) was proposed by DeLone and McLean (1992). The focus of their model is to clarify and connect several outcome variables in common IS research. These variables include: Information Quality, System Quality, IS Use, IS User Satisfaction, Individual Impact, and Organizational Impact. The model has been well-accepted and examined by many researchers (DeLone and McLean, 2003). However, researchers have also pointed to the model's shortcomings. For example, Seddon's (1997) analysis revealed that this IS Success model mixed up process model and variance model. In order to remedy the problem, he modified the IS success model and put in a partial behavioral model of IS use. Seddon, Staples, and Patnayakuni (1999) also noted that IS success and effectiveness measurements should be specified based on two dimensions: Stakeholder and System. The researchers should choose an appropriate IS success measurement based on the research context: 1) success for individuals or a group of stakeholder, 2) success of a technology, a system, or the whole IT function.

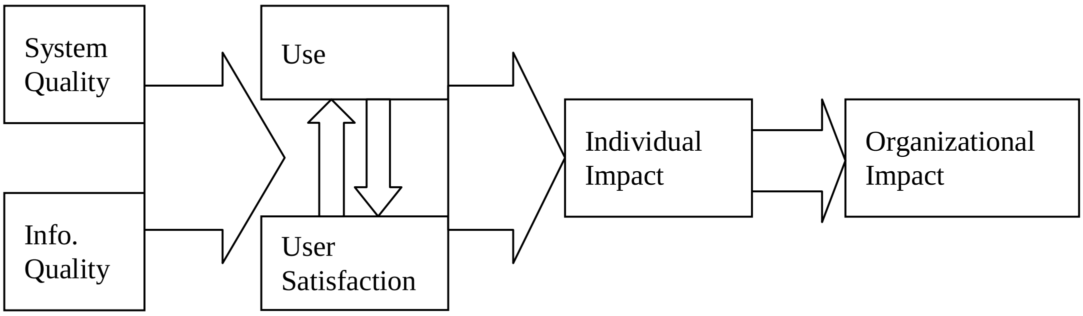

Figure 3.1 The Original IS Success Model (DeLone and McLean, 1992)

In 2003, DeLone and McLean summarized the empirical studies which had utilized their 1992 IS Success model and proposed an extended IS success model (Figure 3.2), which includes the addition of the Service Quality construct. The separation of Use and Intention to use was introduced to solve the problem of unclear causality. To enrich its theoretical foundation, they also cited the communication theory which was proposed by Shannon and Weaver (1949) and extended by Mason (1978). System Quality measures technical level success of an IS which communicates information within an organization. Information Quality represents the semantic level quality of the IS, and the other constructs are indicative of IS effectiveness.

In proposing the IS success models, DeLone and McLean (1992, 2003) presented an overarching IS research framework which provides connections between many IS research topics, such as Information Quality, Service Quality, IS Satisfaction, IS use and acceptance, etc. In a way, these areas are all related to IS success measurements. In a recent article, Gable, Sedera, and Chan (2008) developed a 37-item construct called IS-Impact Measurement Model as another IS Success indicator. The measurement dimensions include Individual Impact and Organizational Impact which represent IS impacts to date and Information Quality and System Quality which reflect the IS impacts anticipated in the future.

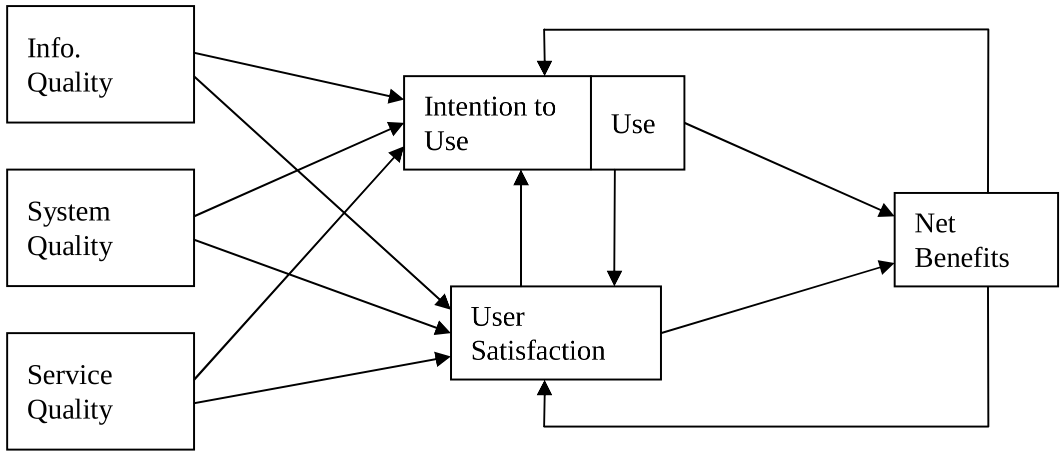

Figure 3.2 Extended IS Success Model (DeLone and McLean, 2003)

3.4 Research on IS Satisfaction and Quality Measurements

Each of the constructs in the original IS Success Model is a measure for one aspect of IS success corresponding to a specific IS research stream. In this section the author briefly reviews four such constructs: IS User Satisfaction, Information Quality, System Quality, and Service Quality. IS User Satisfaction is a central construct for both the IS success model and the IS use continuance model. Consequently, it plays an important role in the integrated model as well. The three quality measurements represent the essential design and functionality perspective of the technological infrastructure, thus they should also be retained in the proposed model.

3.4.1 Information Quality and System Quality

Information is the vital product of an information system (Zmud, 1978). Thus, efforts at attempting to understand information have been a research focus from the infancy of the MIS discipline (Peterson, 1977; Zmud, 1978). The importance of information for a decision maker in the business has been recognized by many early exploratory studies (Feltham, 1968; Peterson, 1977). These studies usually list information quality dimensions based on the researcher's theoretical insights (Zmud, 1978; Swanson, 1985). Today, as many scholars use the term "information economy" to describe the society we live in, the importance of information is undoubtedly more than ever (Ballou, Madnick, and Wang, 2003).

Although the terms used are varied [e.g., "The Value of Information" by Feltham (1968); "The Components of Information" by Peterson (1977); "The Dimensionality of Information" by Zmud (1978); "Information Attributes" by Swanson (1985)], the core concepts are very similar. These researchers all tried to categorize critical information attributes and have successfully identified many types and attributes of information. Lee, Strong, Kahn, and Wang (2002) summarized three major methods to identify information quality dimensions: literature review (DeLone and McLean, 1992; Goodhue, 1995), information consumer (Wang and Strong, 1996), and objective approaches (Ballou and Pazer, 1985; Wand and Wang, 1996).

However, the outcomes are usually too intuitive, atheoretical, and focused only on development characteristics (Ballou and Pazer, 1985; Wang and Strong, 1996). A literature review paper (Wang, Storey, and Firth, 1995) summarized the five most popular information quality dimensions: Accuracy, Reliability, Timeliness, Relevance, and Completeness. McKinney, Yoon, and Zahedi (2002) also identified five major information quality components from literature: Relevance, Timeliness, Reliability, Scope, and Perceived Usefulness. But there is no consensus on the question of what or how many of these dimensions should be considered as part of information quality (Wand and Wang, 1996; McKinney et al., 2002).

Wang and Strong (1996) argued that the information quality (they use the term "data quality") should be context-dependant. That is, the quality of the information must be judged by the criteria of many contextual factors, including information user and the task on hand. Thus, by capturing information users' opinion and preference, Wang and Strong (1996) developed four data quality dimensions: Intrinsic, Contextual, Representational, and Accessibility. Intrinsic data quality is the attributes which are inherent in the information, and Contextual data quality is derived from the contextual factors. Representational and Accessibility data quality are closely attached to the information systems which produce the data (Wang and Strong, 1996; Strong et al., 1997).

Based on the conceptualization proposed by Wang and Strong (1996), Nelson, Todd, and Wixom (2005) used Accuracy (reflecting intrinsic data quality), Completeness and Currency (reflecting contextual quality), and Format (reflecting representational data quality) to be a complete and parsimonious set of information quality dimensions. The Accessibility data quality dimension, according to Nelson et al. (2005), should not be included in information quality because it can be treated as one of the system quality dimensions. McKinney et al. (2002) used Understandability, Reliability, and Usefulness as the three representational components of information quality. Price, Neiger, and Shanks (2008) developed a measurement instrument for subjective aspects of information quality based on the InfoQual framework which define information quality at syntactic, semantic, and pragmatic levels.

Based on the conceptual and theoretical literature on information quality, as summarized above, this study will include these six formative components of the information quality construct: Relevance, Accuracy, Completeness, Currency, Format, and Understandability, as can be seen in Figure 3.3.

System quality has received relatively less attention in the IS literature (Nelson et al., 2005) and is often regarded as equivalent to ease of use (Rai, Lang, and Welker, 2002). System quality dimensions are also often treated only as part of early information quality constructs (Bailey and Pearson, 1983).

Among recent studies, McKinney et al. (2002) reviewed related literature and listed Access, Usability, Navigation, and Interactivity as major system quality components. Nelson et al. (2005) also summarized five dimensions of system quality from around 20 previous studies: Accessibility, Reliability, Flexibility, Response time, and Integration (Nelson et al., 2005). For the current study, as shown in Figure 3.3, dimensions of systems quality include: Reliability, Flexibility, Ease of use, and Response time.

3.4.2 IT Service Quality

Because the support of an IT department is essentially a service to the organization (Pitt, Watson, and Kavan, 1995), many researchers recommend that service quality be used to measure IS success (Kettinger and Lee, 1994; Pitt et al., 1995; Watson, Pitt, and Kavan, 1998; DeLone and McLean, 2003). To accomplish this, they have adapted a scale, SERVQUAL, from service marketing literature (Parasuraman, Zeithaml, and Berry, 1988). However, there are debates on the appropriateness of applying SERVQUAL in an IT context, and some researchers have concerns on the validity, gap model assumption, and the predictive power of SERVQUAL (Kettinger and Lee, 1997; Carr, 2002; Babakus and Boller, 1992).

There are several recent articles regarding how IT service quality should be measured. Some researchers argue that using only the customer's perception on service performance, SERVPERF, is better than SERVQUAL, which is derived from the gap between expectation and actual performance of the service provided (Brady, Cronin, and Brand, 2002; Landrum, Prybutok, and Zhang, 2007). Kettinger and Lee (2005) have extended the gap model of SERVQUAL further. They argued that there should be two levels of expected service: desired and adequate service. Customers' satisfaction can be measured by the difference between perceived service, and each of the two types of expected service. Jia, Reich, and Pearson (2008) argued that IT service quality should not only be judged by customers outside IT. Instead, they proposed an IT service climate construct which is based on views of those employees "inside" the IT department. Main components of the IT service climate construct include supervisory support, coworker support, structural proximity (decentralization), and physical proximity. The author adopts SERVPERF, which contains 4 dimensions of Assurance, Empathy, Responsiveness, and Reliability, for the service quality construct of the current study (see Figure 3.3).

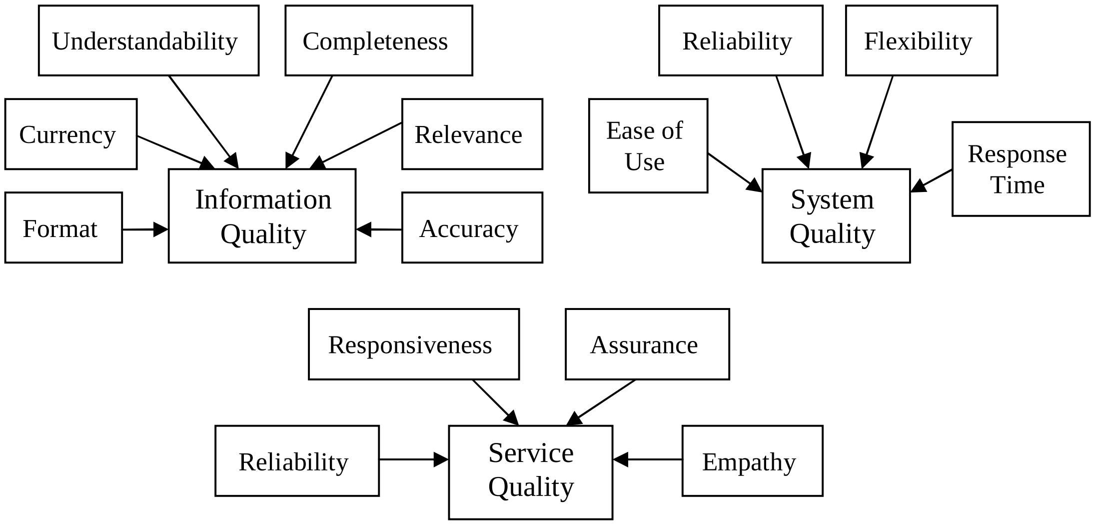

Figure 3.3 Information Quality, System Quality, and Service Quality

3.4.3 IS User Satisfaction

Over the years, IS user satisfaction has been referred to as End-User Computing Satisfaction (EUCS, Doll and Torkzadeh, 1988; Doll, Xia, and Torkzadeh, 1994), User information satisfaction (Ives, Olson, and Baroudi, 1983; Barroudi and Orlikowski, 1988; Sethi and King, 1999), Computer/IS user satisfaction (Bailey and Pearson, 1983; Zviran and Erlich, 2003), and End user satisfaction (EUS, Mahmood, Burn, Gemoets, and Jacquez, 2000; Au, Ngai, and Cheng, 2002; Au et al., 2008).

As DeLone and McLean (1992) indicated in their pivotal IS success paper, "user satisfaction … is probably the most widely used single measure of IS success." Doll and Torkzadeh (1991) proposed a "System to Value Chain" which describes several important causal relationships in the MIS domain. The IS user satisfaction is positioned in the middle of the chain. Thus, "End-user computing satisfaction is an important theoretical construct because of its potential for helping us discover both forward and backward links." (Doll and Torkzadeh, 1991).

Bailey and Pearson (1983) developed a 39-item list for assessing end-user computing satisfaction. Ives et al. (1983) and Baroudi and Orlikowski (1988) re-examined and shortened the list to thirteen and grouped them into categories of "Information Quality," "Staff and Services," and "User Knowledge or Involvement."

Doll and Torkzadeh (1988) proposed five factors for end user computing satisfaction: Content, Accuracy, Format, Ease of use, and Timeliness. This set of factors corresponds to the "Information Quality" factors mentioned both by Baroudi and Orlikowski (1988) and DeLone and McLean (1992). In the follow-up studies, the five-factor measurements are proved valid and stable in methodological tests and in various industries (Doll et al., 1994; Somers, Nelson, and Karimi, 2003; Doll, Deng, Raghunathan, Torkzadeh, and Xia, 2004).

However, these measures have been criticized as lacking theoretical foundation and with weak empirical support (Goodhue, 1995). Sethi and King (1999) also challenged the linear relationship between attributes and satisfaction, an assumption that is made by above-mentioned studies. In summary, high levels of IS attribute evaluation do not necessarily result in high

IS user satisfaction measurement (Mahmood and Becker, 1985; DeLone, 1988; Au et al., 2002).

A number of researchers have criticized IS/IT satisfaction research as “atheoretical” (Briggs, Reinig, and De Vreede, 2008), “relatively limited” (Au et al., 2002), and “progress … is taking place very slowly” (Au et al., 2008). Briggs et al. (2008) identified ten different satisfaction effects and summarized six existing models for satisfaction from the literature. However, each model has its limitations and a user satisfaction theory which can explain all satisfaction effects is still unavailable.

Moreover, Briggs et al. (2008) also mentioned a case in which an executive team declined to further use a group support system because they felt dissatisfied after using the system even though the output quality was better than expected and the system was easy to use. In such a case (and they claimed they met many similar ones), satisfaction obviously is a critical factor. Using the case as a support, they argued that user satisfaction should be an “affective” construct and not a “judgment” one which can be derived from various dimensions and features (Briggs et al., 2008). One will follow their conceptualization on IS user satisfaction by treating this measure as an affective scale for this research model.

3.5 IS Use Continuance: After System Adoption

Information systems are pervasive in its use throughout the organization (Keil, Mann, and Rai, 2000), and the challenges in its implementation grow as the systems become increasingly complex. The TAM (Technology Acceptance Model) which was introduced twenty years ago, focused on the initial adoption of a system. Many recent studies, however, recognized that the challenges in implementation have more to do with post-adoption problems that are beyond the initial acceptance (Jasperson, Carter, and Zmud, 2005). In summary, factors determining IS use continuance are different from those affecting initial acceptance outcomes (Karahanna, Straub, and Chervany, 1999; Taylor and Todd, 1995; Venkatesh and Morris, 2000; Venkatesh, Morris, Davis, and Davis, 2003).

Limayem, Hirt, and Cheung (2007) indicate that Bhattacherjee's work (2001) finally identifies factors which can determine the continued usage behavior and provides a fresh theoretical foundation beyond what is used in adoption studies. The post-acceptance model of IS continuance (Bhattacherjee, 2001; Figure 3.4) is based on Expectation-disconfirmation Theory (EDT, Oliver, 1980) and contains expectation, perceived performance, confirmation, satisfaction, and intention. Bhattacherjee's model (2001) posits that users' satisfaction influences their intention to continually use the system, and the confirmation construct, which is based on the gap between users' expectation and actual use experience, affects satisfaction. The users' confirmation toward the system also lead to its "usefulness" as they perceived. If the use experience is positive compared to what they expected, users would consider the system more useful. Conversely, if users feel disappointed and frustrated after usage, they will not evaluate the system as highly useful. The perceived usefulness would then lead to continuance intention.

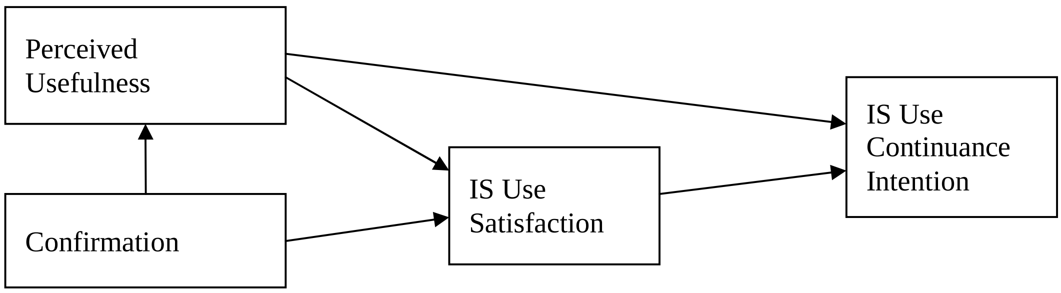

Figure 3.4 Post-Acceptance Model of IS Continuance
(Bhattacherjee, 2001)

3.6 The Integration of IS Success and IS Use Continuance

3.6.1 EDT: The Theoretical Underpinning for Model Integration

Theory is a fundamental element of a research model (Gregor, 2006). Thus, the author has to identify the theoretical underpinning of this proposed model. The original IS success model has been criticized as atheoretical (Seddon, 1997). In response, the updated IS success model (DeLone and McLean, 2003) incorporated communication theory (Shannon and Weaver, 1949) and a part of it is utilized to support the new model.

For the IS use continuance model, Bhattacherjee (2001) successfully adapted the Expectation-disconfirmation theory (EDT) and applied it in the IS domain. This model provides new insights into post-adoption behaviors (Limayem et al., 2007). To be successful, a system should at least have been used by the users for an extended period of time. Therefore, this proposed model is positioned in an IS use continuance context, and the EDT should be an appropriate theoretical foundation for the research model as proposed.

As a widely applied theory regarding consumer behavior, the EDT demonstrated its contributions in the areas of consumer satisfaction, post-purchase behavior, and service marketing (Anderson and Sullivan, 1993; Oliver, 1980, 1997; Tse and Wilton, 1988). Expectations were formed by consumers toward the product or service they intend to purchase. After the purchase and consumption, they assessed the perceived performance versus their original expectation and formed a confirmation (i.e., performance is better than expectation) or disconfirmation (i.e., performance does not meet expectation) toward the product or service consumed. Next, the assessment result (confirmation or disconfirmation) lead to satisfaction (or dissatisfaction). Fazio and Zanna (1981) suggested that satisfaction based on actual use experience is a more realistic and unbiased predictor of intention than pre-acceptance attitude.

As the theoretical underpinning of the IS use continuance model, EDT has gained acceptance by IS researchers and been applied in related studies (Limayem et al., 2007).

3.6.2 Perceived Needs Fulfillment

Au et al. (2008) indicate that system users can feel satisfaction when they use the system to fulfill any of the three basic human needs: existence, relatedness, and self-development (Alderfer, 1969). We argue that it is even so in a use continuance context because in such contexts users fully understand the system's functions and capabilities and how to leverage them. Davis' perceived usefulness (1989), however, is focused on the work performance aspect only. In other words, traditional usefulness measures only existence need fulfillment which pertains to an employee's need to maintain status and resources in an organization.

To fully incorporate other two aspects of usefulness (relatedness and self-development), the author proposed a more general "usefulness" construct which formatively consists all three needs fulfillment components: perceived extended usefulness, perceived relatedness fulfillment, and perceived self-development fulfillment. Among them, the extended usefulness can be further represented by two reflective dimensions: perceived efficiency and perceived effectiveness (Drucker, 1967). The term "perceived needs fulfillment" is used to refer to this construct which covers all of the various usefulness constructs as mentioned above.

3.6.3 System Use and Its Predictors

Bhattacherjee's model (2001) treats the use continuance intention as the final dependent variable, which can be expected to determine the behavior of further IS usage. Several recent studies discuss the IS use construct and reveal other factors which can also predict IS use. A thorough examination on these recent developments is required for the purpose of proposing an integrated IS success model.

Burton-Jones and Gallivan (2007) indicate that IS use is a key construct in various IS research domains. Surprisingly, the conceptualization and operationalization of such an important construct have not been systematically examined until recently (Burton-Jones and Straub, 2006; Barki, Titah, and Boffo, 2007). The IS researchers generally agree that IS use is a complex phenomenon and, thus, should have a richer conceptualization (Jasperson et al., 2005; Barki et al., 2007; Burton-Jones and Gallivan, 2007; Doll and Torkzadeh, 1998). Venkatesh, Brown, Maruping, and Bala (2008) proposed that the three most common IS use conceptualizations are Duration, Frequency, and Intensity of use. In order to successfully incorporate various forms of usage behaviors in the proposed model, therefore, the author formulates the system use as a formative construct (Petter, Straub, and Rai, 2007) which contains the components of duration, intensity (or depth), and frequency of usage in the current study.

In addition to the assumed IS use predictor of behavioral intention, a recent study has revealed that habit is also an important predictor of IS usage in a use continuance context (Limayem et al., 2007). After an extended period of system implementation, the system use gradually becomes a learned response to certain occasions. The IT implementation model proposed by Saga and Zmud (1994) describes similar phenomena in the stages of routinization and infusion for an organization. From an external view, Facilitating Condition refers to “the degree to which an individual believes that an organizational and technical infrastructure exists to support of use of the system.” In Venkatesh’s Unified Theory of Adoption and Use of Technology (UTAUT) (Venkatesh et al., 2003), this is a direct predictor of system use.

3.7 Research Model and Methodology

3.7.1 Research Model

The author proposed a theoretically integrated model of IS success as shown in Figure 3.5. Information Quality, System Quality and Service Quality, which are included in DeLone and McLean’s IS success model (2003) measure the system’s outputs, features, and its supporting resources. In the context of IS continuance, the system use experience, as reflected by Information Quality and System Quality, is a basis for forming the IS Use Confirmation, which in turn affects Needs Fulfillment and Satisfaction. Service Quality impacts the perception of Facilitating Condition, a broader construct regarding attributes of the general system infrastructure.

Other predictors included in the research model, including Continuance Intention, Facilitating Conditions, and Habit, were discussed earlier. However, given the theoretical context of the model, which is centered on use continuance and long-term use, it is argued that habit should play a critical role because “habit simplifies the movements required to achieve a given result, makes them more accurate and diminishes fatigue” (James, 1890).

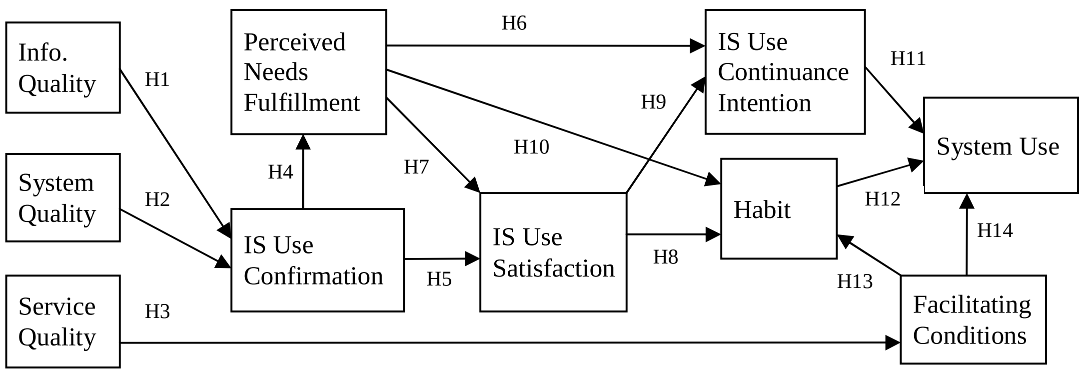

Figure 3.5: The Proposed Research Model

3.7.2 Hypotheses

The information that the system provides and the system features that users utilize are the essential basis upon which they form their confirmation which reflects the assessment of the difference between actual use experience and expectation. Thus,

H1: The users' perceived information quality of the system is positively associated with their extent of confirmation.

H2: The users' perceived system quality is positively associated with their extent of confirmation.

The service quality of the IT department which supports the system in question can be expected to affect the facilitating conditions as perceived by users who rely upon resources from the general technological infrastructure. Therefore,

H3: Users' perceived service quality of the IT department is positively associated with their assessment of facilitating conditions of the system.

A fundamental argument of EDT (Oliver, 1980) is that the perception gap between user's expectation and actual consumption determines user's satisfaction. Therefore, IS use confirmation, which represents the perception gap, leads to users' satisfaction. Moreover, according to Cognitive Dissonance Theory (CDT: Festinger, 1957), users will modify user's perception on the general usefulness of the system according to the confirmation user feel to avoid cognitive dissonance. In other words, when users feel that the system's performance is better than their original expectation, they will increase their evaluation on the system's usefulness and vice versa. Thus,

H4: Users' extent of confirmation is positively associated with their perceived needs fulfillment from using the system.

H5: Users' extent of confirmation is positively associated with their satisfaction with the system.

In this study, the "usefulness" concept has been expanded to a more general need-based fulfillment, but the predictive validity of the expanded construct should remain the same. Since Bhattacherjee's IS Continuance Model (2001) already proposed and proved the relationships from usefulness to satisfaction and from usefulness to continuance intention, it is hypothesized that both these relationships will still hold in this research model:

H6: Users' perceived needs fulfillment from using the system is positively associated with their IS use continuance intention.

H7: Users' perceived needs fulfillment from using the system is positively associated with their satisfaction with IS use.

EDT (Oliver, 1980) and IS Success Model (DeLone and McLean, 2003) both posit that user satisfaction can lead to intention to use. Indeed, satisfaction that users feel reinforces the intention to perform a behavior. Similarly, satisfaction can increase people's tendency to repeat a behavior (Aarts, Verplanken, and Van Knippenberg, 1998). Thus, satisfaction also plays a key condition for habit development toward that behavior. Therefore,

H8: Users' satisfaction with IS use is positively associated with their IS use habit.

H9: Users' level of satisfaction with IS use is positively associated with their IS use continuance intention.

Even though the Limayem et al. (2007) model does not incorporate a relationship from usefulness to habit, we argue that there is a link from needs fulfillment to habit. Habit can be defined as a mindset under which an individual performs certain behavior automatically (Orbell, Blair, Sherlock, and Connor, 2001). As previously proposed in H7 and H8, the relationship between needs fulfillment to Habit is mediated through satisfaction. However, needs fulfillment provides a long-term substantive basis for habit formation. If users do not feel that their fundamental needs are being fulfilled, they would not wholeheartedly devote themselves to the use of the system. Thus, to the extent that the system helps them to fulfill fundamental needs, they would use the system almost automatically and start to form a habit:

H10: Users' perceived needs fulfillment from using the system is positively associated with their IS use habit.

Several classical theories and models in the technology acceptance research stream adopt behavioral intention as the primary predictor of actual behavior, such as the theory of reasoned actions (Fishbein and Ajzen, 1975), theory of planned behavior (Ajzen, 1991), and TAM (Davis, 1989). However, when using system becomes a habit, users perform the usage behavior in an automatic way without much conscious attention (Orbell et al., 2001). Limayem et al. (2007) indicated that the existence of habit can limit the predictive power of behavioral intention. Therefore,

H11: Users' IS use continuance intention is positively associated with their system use.

H12: Users' IS use habit is positively associated with their system use.

In the UTAUT model (Venkatesh et al., 2003), facilitating condition reflects the general circumstances of the system implementation environment and thus predicts actual system adoption. Limayem et al. (2007) also list stable context as one of the antecedents of habit but does not empirically test it. It is agreed that a good facilitating condition can enhance actual system use and reinforce usage habit formation. Thus,

H13: Facilitating condition of the system is positively associated with IS use habit.

H14: Facilitating condition of the system is positively associated with system use.

3.7.3 Data Collection

The subjects in this research are students who enrolled in graduate-level business school courses at a public university in the south. Most of them are graduate students, but some combined sections include undergraduate students. Paper-based surveys are used in the classroom for data collection. The target population is business professionals who utilize information systems to perform their jobs. Since most of the business graduate students in this school work as full-time or part-time employees and the author clearly indicated that the respondents need to answer the questionnaire based on their system use experience in an office setting, it is certain that these data are collected from intended population in our research design.

Respondents first need to identify an information system based on several criteria and list three major activities or decisions in their job and the information they obtained from the identified system to support those activities or decisions. The subjects will be mentally prepared for later questions after such exercise. The system selection criteria include: (1) the system should be important to their job; (2) the system should be supported by the IT department of their organization; (3) the system should provide information regularly; and (4) they choose only one module for a large scale system (such as an ERP system). These criteria can further clarify the type of information systems intended to be studied and make sure the respondents choose the target system carefully and answer questions mindfully.

3.7.4 Construct Development and Pilot Test

The items of the Information and System Quality constructs are adapted from several previous studies: McKinney et al. (2002), Nelson et al. (2005), Lee et al. (2002), Davis (1989), and Gable et al. (2008). For Service Quality, the author adopts the SERVPREF which contains four components as suggested by Jiang, Klein, and Karr (2002). The three quality constructs are all second-order formative constructs (Petter et al., 2007). Each of the constructs is combined by several components based on prior literature and the detailed structures are depicted previously in Figure 3.3.

Based on the EDT theory (Oliver, 1980), the confirmation or disconfirmation resulted from the difference between expectation and actual usage experience is the predictor of needs fulfillment and satisfaction. To be consistent, the three quality measures in this study are stated in the form of confirmation or disconfirmation.

All items for Information, System, and Service Quality constructs are seven-point Likert scale adapted from previous studies (see the appendix) and the author modified the response anchors from "-3: Much lower than I expected" to "+3: Much higher than expected" to emphasize its disconfirmation orientation. The IS use confirmation is measured by seven-point Likert scale but with anchors from "1: Strongly Disagree" to "7: Strongly Agree" and with a phrase "… better than I expected" in the item statement (see the appendix). Spreng and Page (2003) indicated that incorporating a phrase like "better than expected" in the measurement item statements or anchors is one of the preferred choices for researchers to capture the responses of disconfirmation constructs.

There are six remaining constructs in the research model: Perceived Needs Fulfillment, IS Use Satisfaction, IS Use Continuance Intention, Habit, Facilitating Condition, and System Use. All of the six constructs and their items are adapted from previous studies, and detailed information is listed in the appendix. Among them, Perceived Needs Fulfillment and System Use are formative constructs (Petter et al., 2007). System Use is formed by three direct measures of usage: Duration, Intensity (or Depth), and Frequency. The author uses these three forms of system usage because they are most commonly used in previous studies (Venkatesh et al., 2008). Perceived Needs Fulfillment, however, is a second-order formative construct based on several reflective constructs: Perceived Efficiency, Perceived Effectiveness, Relatedness Fulfillment, and Self-Development Fulfillment. These four reflective constructs and the other four main constructs mentioned earlier are all measured by seven-point Likert scale anchored from "Strongly Agree" to "Strongly Disagree."

The Perceived Needs Fulfillment items are adapted from Davis (1989) (for Perceived Efficiency and Perceived Effectiveness) and Au et al. (2008) (for Relatedness Fulfillment and Self-Development Fulfillment). To measure the IS User Satisfaction as an affective construct, we use items such as "I feel delighted …," "I am satisfied …," and "I am pleased …" which are adapted from Au et al. (2008), Briggs et al. (2008), and Bhattacherjee (2001). The items of IS use Continuance Intention are drawn from the work of Bhattacherjee (2001). Items for the Habit construct are directly adopted from Limayem et al. (2007). Facilitating Condition and System Use items are adapted from Venkatesh et al. (2008).

The author conducted a pilot test with university faculty members and IS doctoral students to ensure content validity on these measurement scales (Straub, Boudreau, and Gefen, 2004). The questionnaire was then updated according to their feedback and suggestions.

3.8 Data Analysis

3.8.1 Data Analysis Methodology

The data analysis is conducted using Partial Least Square (PLS: Fornell and Bookstein, 1982) technique and the software utilized is SmartPLS 2.0 (Ringle, Wende, and Will, 2005). PLS is widely adopted in various disciplines for the reason that it can handle formative latent variables under the conditions of non-normality, non-independence, and limited sample size (Chin, 1998; Chin and Gopal, 1995; Chin and Newsted, 1999).

3.8.2 Data Screening, Data Characteristics, and Control Variable Analysis

All surveys gathered were examined during the data key-in process by one of the authors. Out of the total 358 samples collected originally, 47 questionnaires were deemed to be inappropriate for data analysis. Major reasons included a high percentage of missing values, careless responses such as monotone or patterned answers, and selecting the wrong target (such as computer software) to answer the survey. The final dataset after data screening has 311 eligible samples. Next, the dataset was checked for univariate outliers (Hair, Black, Babin, Anderson, and Tatham, 2006). The organization size, a control variable which ranges from 2 to 300,000 (in number of employees), contains several outlier data points. Those samples with outlier values were inspected and they are all valid responses. Moreover, organization size proved to be an insignificant control variable in the later section. Thus, no samples were removed due to the outlier analysis.

Demographic data of the final dataset were summarized in Table 3.1. Most of the respondents are aged between 20-40 years, holding a bachelor's degree, working as an employee or manager in the current organization for an average of 4.5 years, and using the system for an average of 37 months. The profile of the respondents confirmed that they are knowledge workers who utilize information systems in an organization to perform their daily job.

We test the relationships between control variables and endogenous (dependent) variables to identify alternative explanations. All control variables tested include: Age, Education, Gender, Organization industry, Organization size, Job title, Tenure with organization, Tenure with current position, Voluntariness, System adoption time, and System importance. Only System Importance was significantly linked to Perceived Needs Fulfillment and System Use, thus System Importance will be included in the research model.

Table 3.1 Data Characteristics

Demographic Variable	Category	Count	Percentage
Age	20 and below	4	1.3
	21-30	178	57.2
	31-40	90	28.9
	41-50	31	10.0
	51-60	6	1.9
Education	High School Degree	8	2.6
	Associate Degree	6	1.9
	Bachelor Degree	194	62.4
	Master Degree	95	30.5
	Doctorate Degree	4	1.3
Gender	Male	188	60.5
	Female	120	38.6
Organization Industry	Manufacturing	46	14.8
	Banking/Insurance/Financial Service	55	17.7
	Hotel/Entertainment/Service Industry	14	4.5
	Construction/Architecture/Engineering	27	8.7
	IT/Telecommunications	20	6.4
	Consulting/Business Service	13	4.2
	Health Care	20	6.4
	Government/Military	23	7.4
	Education	13	4.2
	Other	78	25.1
Job Title	Employee	150	48.2
	Manager	60	19.3
	Executive	19	6.1
	Professional	13	4.2
Organization Size	Range from 2 to 300,000; Mean 11,796 (employees)		
Tenure with Organization	Range from 0.1 to 30; Mean 4.53 (years)		
Tenure with Current Position	Range from 0.1 to 25; Mean 2.67 (years)		
System Adoption Time	Range from 1 to 242; Mean 37; Mode 24 (months)		

3.8.3 Validities of Measurement Scales

The measurement model (or outer model) of PLS concerns the relationships between latent variables and their manifest variables (Chin and Newsted, 1999). Before examining the measurement model, multicollinearity issue (Diamantopoulos and Winklhofer, 2001) was first considered. The VIF scores of two satisfaction items (Sarisf2 and Satisf4) are higher than ten, thus both items were dropped.

In Table 3.2, correlations between individual items and major constructs are presented. Convergent validity can be proved in that each item loads to its latent variable with a coefficient higher than 0.7, as the bolded figures in Table 3.2 demonstrated (Gefen and Straub, 2005). Three construct items, FaciCond3, FaciCond4, and SysQ-EOU1 were removed for low loadings. The same table can also show discriminant validity by comparing one construct's item loadings to all other loadings. All items left demonstrated good discriminant validity in Table 3.2. To be noted, the three quality constructs, Perceived Needs Fulfillment, and System Use are not included in Table 3.2 because such validity checks are not meaningful to these formative constructs (Petter et al., 2007).

The author further examined the composite reliability, average variance extracted (AVE), and the correlations between main constructs in Table 3.3. Composite reliability should be higher than 0.7 (Hair et al., 2006) and AVE should be higher than 0.5 (Fornell and Larcker, 1981). Since only square roots of AVE scores are listed in Table 3.3 (bolded figures), the standard is 0.707

(square root of 0.5). With composite reliability at 0.89 or above and AVE square root at 0.86 or above, it can be concluded that the model constructs again showed a good convergent validity. Discriminant validity can also be further examined by comparing one construct's AVE square root with its correlations to other constructs (Fornell and Larcker, 1981). The figures in table 3.3 demonstrated that all constructs listed share a greater variance with its own set of items (AVE square root) than with other constructs (correlations). Overall, it is concluded that the validities of the measurement scales are affirmed.

Table 3.2 Correlations of Individual items to Constructs

	UCI	CF	EFC	EFI	RF	SDF	SA	HA	FC	IQAC	IQCO
CUseInten1	**0.94**	0.68	0.58	0.63	0.50	0.52	0.74	0.58	0.39	0.41	0.48
CUseInten2	**0.93**	0.68	0.53	0.60	0.48	0.52	0.75	0.60	0.35	0.39	0.48
CUseInten3	**0.80**	0.41	0.37	0.44	0.26	0.34	0.53	0.38	0.23	0.29	0.32
Confirm1	0.65	**0.90**	0.60	0.67	0.49	0.54	0.72	0.63	0.41	0.40	0.58
Confirm2	0.61	**0.91**	0.53	0.61	0.40	0.46	0.70	0.54	0.34	0.46	0.56
Confirm3	0.56	**0.86**	0.51	0.57	0.40	0.45	0.62	0.52	0.39	0.42	0.44
Effecti2	0.45	0.49	**0.89**	0.74	0.49	0.44	0.45	0.59	0.38	0.30	0.32
Effecti3	0.51	0.57	**0.90**	0.69	0.58	0.57	0.52	0.57	0.36	0.28	0.35
Effecti4	0.57	0.60	**0.93**	0.82	0.52	0.51	0.56	0.59	0.38	0.30	0.40
Efficien1	0.61	0.64	0.76	**0.92**	0.46	0.45	0.55	0.62	0.42	0.40	0.42
Efficien2	0.57	0.64	0.78	**0.91**	0.44	0.44	0.57	0.65	0.50	0.36	0.40
Efficien4	0.58	0.65	0.77	**0.94**	0.47	0.47	0.58	0.65	0.47	0.36	0.41
RelatNF1	0.46	0.50	0.58	0.47	**0.91**	0.74	0.47	0.45	0.32	0.27	0.33
RelatNF2	0.38	0.38	0.49	0.42	**0.87**	0.68	0.39	0.31	0.18	0.25	0.28
RelatNF3	0.46	0.44	0.51	0.44	**0.94**	0.75	0.44	0.38	0.20	0.24	0.29
SelfDNF1	0.50	0.51	0.54	0.46	0.79	**0.91**	0.50	0.36	0.24	0.27	0.37
SelfDNF2	0.47	0.49	0.49	0.42	0.72	**0.94**	0.48	0.34	0.21	0.27	0.36
SelfDNF3	0.49	0.51	0.52	0.48	0.69	**0.93**	0.51	0.34	0.23	0.27	0.36
Satisf1	0.68	0.71	0.51	0.54	0.44	0.47	**0.94**	0.49	0.30	0.45	0.53
Satisf3	0.76	0.75	0.56	0.60	0.46	0.51	**0.96**	0.54	0.35	0.52	0.57
Satisf5	0.70	0.69	0.50	0.53	0.43	0.52	**0.91**	0.49	0.34	0.45	0.54
Satisf6	0.74	0.73	0.54	0.60	0.48	0.52	**0.95**	0.53	0.36	0.50	0.55
Habit1	0.52	0.56	0.55	0.62	0.33	0.28	0.47	**0.93**	0.54	0.23	0.31
Habit2	0.59	0.60	0.58	0.62	0.41	0.37	0.52	**0.94**	0.54	0.23	0.32
Habit3	0.53	0.59	0.65	0.67	0.42	0.39	0.51	**0.89**	0.44	0.26	0.37
FaciCond1	0.37	0.42	0.39	0.49	0.23	0.22	0.34	0.52	**0.95**	0.15	0.15
FaciCond2	0.35	0.39	0.40	0.46	0.25	0.24	0.34	0.53	**0.95**	0.11	0.14

Table 3.2 – *Continued*

IQ-Accu1	0.38	0.42	0.34	0.38	0.29	0.29	0.45	0.25	0.15	**0.87**	0.54
IQ-Accu2	0.32	0.37	0.23	0.29	0.21	0.23	0.42	0.16	0.07	**0.89**	0.50
IQ-Accu3	0.40	0.48	0.30	0.41	0.24	0.26	0.51	0.28	0.15	**0.93**	0.59
IQ-Comp1	0.45	0.59	0.39	0.42	0.34	0.38	0.56	0.37	0.20	0.57	**0.90**
IQ-Comp2	0.44	0.52	0.34	0.41	0.26	0.33	0.53	0.32	0.16	0.53	**0.92**
IQ-Comp3	0.44	0.51	0.35	0.37	0.31	0.36	0.50	0.29	0.06	0.57	**0.90**
IQ-Curr1	0.33	0.37	0.31	0.31	0.27	0.27	0.42	0.23	0.12	0.58	0.52
IQ-Curr2	0.36	0.40	0.37	0.37	0.28	0.31	0.47	0.31	0.13	0.60	0.54
IQ-Curr3	0.42	0.44	0.36	0.40	0.29	0.34	0.50	0.31	0.13	0.66	0.56
IQ-Form1	0.53	0.53	0.30	0.38	0.30	0.35	0.60	0.31	0.15	0.57	0.68
IQ-Form2	0.55	0.54	0.32	0.40	0.33	0.37	0.61	0.36	0.20	0.50	0.66
IQ-Form3	0.50	0.48	0.31	0.39	0.29	0.31	0.53	0.35	0.17	0.49	0.57
IQ-Rele1	0.45	0.53	0.49	0.49	0.37	0.35	0.55	0.44	0.25	0.45	0.59
IQ-Rele2	0.40	0.49	0.44	0.48	0.36	0.32	0.47	0.38	0.24	0.44	0.57
IQ-Rele3	0.43	0.51	0.33	0.39	0.25	0.32	0.51	0.34	0.20	0.47	0.66
IQ-Unde1	0.46	0.53	0.34	0.40	0.25	0.27	0.54	0.34	0.25	0.66	0.60
IQ-Unde2	0.50	0.49	0.35	0.43	0.29	0.25	0.53	0.40	0.26	0.51	0.57
IQ-Unde3	0.50	0.47	0.32	0.40	0.29	0.25	0.52	0.35	0.26	0.51	0.52
SerQ-Assu1	0.23	0.31	0.19	0.22	0.13	0.16	0.32	0.13	0.06	0.31	0.28
SerQ-Assu2	0.17	0.25	0.18	0.17	0.22	0.20	0.22	0.15	0.08	0.23	0.21
SerQ-Assu3	0.24	0.38	0.32	0.37	0.22	0.22	0.34	0.32	0.19	0.39	0.39
SerQ-Empa1	0.26	0.29	0.24	0.28	0.17	0.16	0.24	0.27	0.19	0.29	0.26
SerQ-Empa2	0.20	0.26	0.18	0.22	0.12	0.14	0.21	0.18	0.17	0.26	0.20
SerQ-Empa3	0.22	0.30	0.22	0.24	0.19	0.22	0.27	0.14	0.13	0.31	0.31
SerQ-Empa4	0.28	0.36	0.30	0.33	0.19	0.23	0.29	0.28	0.23	0.32	0.32
SerQ-Reli1	0.27	0.32	0.21	0.25	0.09	0.19	0.31	0.20	0.08	0.34	0.28
SerQ-Reli2	0.29	0.30	0.21	0.25	0.09	0.20	0.31	0.18	0.10	0.33	0.28
SerQ-Reli3	0.24	0.32	0.24	0.26	0.08	0.16	0.27	0.19	0.08	0.32	0.29
SerQ-Resp1	0.29	0.35	0.23	0.28	0.12	0.20	0.32	0.21	0.13	0.32	0.32
SerQ-Resp2	0.27	0.30	0.25	0.24	0.15	0.22	0.31	0.20	0.12	0.29	0.28
SerQ-Resp3	0.24	0.28	0.19	0.19	0.17	0.21	0.29	0.17	0.08	0.24	0.21
SysQ-EOU2	0.38	0.42	0.30	0.39	0.19	0.15	0.43	0.42	0.35	0.36	0.43
SysQ-EOU3	0.47	0.48	0.32	0.37	0.25	0.23	0.51	0.41	0.28	0.35	0.49
SysQ-EOU4	0.52	0.50	0.30	0.37	0.30	0.34	0.53	0.39	0.25	0.38	0.50
SysQ-EOU5	0.39	0.44	0.21	0.30	0.24	0.24	0.51	0.36	0.29	0.36	0.44
SysQ-EOU6	0.50	0.55	0.31	0.39	0.34	0.32	0.56	0.42	0.27	0.44	0.51
SysQ-EOU7	0.54	0.55	0.36	0.44	0.29	0.31	0.57	0.48	0.33	0.42	0.56
SysQ-EOU8	0.47	0.51	0.29	0.38	0.24	0.26	0.52	0.42	0.31	0.38	0.53
SysQ-Flex1	0.41	0.43	0.30	0.31	0.30	0.33	0.46	0.22	0.14	0.45	0.49
SysQ-Flex2	0.38	0.42	0.26	0.29	0.28	0.32	0.47	0.18	0.12	0.46	0.47
SysQ-Flex3	0.51	0.55	0.36	0.39	0.31	0.37	0.58	0.43	0.27	0.46	0.58
SysQ-Reli1	0.33	0.35	0.28	0.31	0.19	0.16	0.33	0.29	0.22	0.33	0.26
SysQ-Reli2	0.43	0.45	0.32	0.34	0.24	0.24	0.45	0.27	0.17	0.47	0.35
SysQ-Reli3	0.39	0.44	0.30	0.33	0.20	0.23	0.42	0.30	0.21	0.44	0.35
SysQ-Resp1	0.37	0.45	0.33	0.37	0.24	0.27	0.46	0.36	0.21	0.47	0.40
SysQ-Resp2	0.31	0.43	0.27	0.28	0.21	0.25	0.43	0.25	0.15	0.50	0.42
SysQ-Resp3	0.33	0.40	0.24	0.29	0.19	0.22	0.41	0.28	0.16	0.46	0.37

UCI: Use Continuance Intention
CF: IS Use Confirmation
EFC: Perceived Effectiveness
EFI: Perceived Efficiency
RF: Relatedness Fulfillment
SDF: Self-Development Fulfillment
SA: IS User Satisfaction
HA: Habit
FC: Facilitating Conditions
IQAC: Information Quality – Accuracy
IQCO: Information Quality – Completeness

Table 3.2 – *Continued*

	IQCU	IQFO	IQRE	IQUN	RQAS	RQEM	RQRL	RQRP	SQEU	SQFL	SQRL	SQRP
CUseInten1	0.40	0.55	0.47	0.54	0.27	0.28	0.29	0.31	0.54	0.50	0.44	0.36
CUseInten2	0.39	0.54	0.47	0.51	0.24	0.25	0.25	0.28	0.54	0.47	0.36	0.34
CUseInten3	0.27	0.40	0.33	0.35	0.14	0.18	0.21	0.22	0.35	0.34	0.31	0.25
Confirm1	0.39	0.53	0.57	0.52	0.32	0.32	0.26	0.31	0.56	0.51	0.36	0.35
Confirm2	0.40	0.54	0.52	0.50	0.36	0.33	0.36	0.37	0.52	0.50	0.43	0.43
Confirm3	0.39	0.40	0.44	0.42	0.28	0.27	0.26	0.26	0.45	0.43	0.43	0.43
Effecti2	0.35	0.25	0.41	0.31	0.21	0.21	0.17	0.19	0.26	0.27	0.28	0.23
Effecti3	0.35	0.31	0.41	0.34	0.24	0.25	0.21	0.24	0.35	0.35	0.28	0.27
Effecti4	0.34	0.34	0.47	0.36	0.28	0.26	0.25	0.26	0.35	0.34	0.33	0.31
Efficien1	0.36	0.43	0.48	0.41	0.28	0.27	0.27	0.24	0.42	0.38	0.37	0.36
Efficien2	0.34	0.36	0.46	0.42	0.27	0.31	0.23	0.25	0.39	0.34	0.32	0.28
Efficien4	0.38	0.38	0.50	0.43	0.27	0.26	0.24	0.26	0.42	0.35	0.30	0.29
RelatNF1	0.30	0.29	0.35	0.30	0.18	0.19	0.09	0.14	0.30	0.31	0.21	0.24
RelatNF2	0.24	0.32	0.31	0.28	0.20	0.17	0.07	0.17	0.26	0.31	0.19	0.14
RelatNF3	0.29	0.29	0.33	0.24	0.21	0.17	0.09	0.15	0.28	0.30	0.21	0.24
SelfDNF1	0.33	0.38	0.34	0.29	0.21	0.20	0.19	0.22	0.35	0.39	0.22	0.24
SelfDNF2	0.29	0.33	0.33	0.25	0.19	0.18	0.17	0.20	0.24	0.34	0.20	0.24
SelfDNF3	0.30	0.32	0.35	0.24	0.22	0.20	0.19	0.23	0.27	0.36	0.22	0.25
Satisf1	0.47	0.56	0.52	0.50	0.32	0.27	0.28	0.32	0.55	0.55	0.39	0.42
Satisf3	0.51	0.62	0.57	0.60	0.34	0.28	0.31	0.34	0.59	0.57	0.47	0.45
Satisf5	0.43	0.58	0.50	0.53	0.30	0.29	0.31	0.36	0.57	0.55	0.38	0.43
Satisf6	0.49	0.60	0.57	0.57	0.31	0.25	0.26	0.31	0.57	0.54	0.42	0.44
Habit1	0.26	0.33	0.35	0.35	0.18	0.21	0.17	0.19	0.45	0.28	0.30	0.28
Habit2	0.25	0.38	0.40	0.42	0.22	0.23	0.19	0.22	0.49	0.33	0.28	0.28
Habit3	0.34	0.29	0.46	0.34	0.22	0.24	0.20	0.21	0.39	0.29	0.29	0.32
FaciCond1	0.13	0.17	0.25	0.25	0.15	0.22	0.11	0.15	0.31	0.20	0.23	0.20
FaciCond2	0.12	0.19	0.23	0.28	0.10	0.17	0.07	0.09	0.34	0.19	0.17	0.15
IQ-Accu1	0.65	0.51	0.48	0.53	0.33	0.33	0.31	0.30	0.41	0.51	0.45	0.47
IQ-Accu2	0.51	0.45	0.38	0.49	0.23	0.22	0.25	0.20	0.35	0.41	0.34	0.37
IQ-Accu3	0.63	0.53	0.51	0.63	0.39	0.35	0.37	0.34	0.44	0.48	0.43	0.50
IQ-Comp1	0.51	0.64	0.64	0.60	0.33	0.29	0.32	0.34	0.57	0.55	0.36	0.42
IQ-Comp2	0.53	0.63	0.62	0.57	0.28	0.27	0.26	0.26	0.53	0.55	0.30	0.37
IQ-Comp3	0.56	0.60	0.61	0.53	0.33	0.30	0.24	0.25	0.48	0.51	0.31	0.37
IQ-Curr1	**0.91**	0.44	0.46	0.46	0.35	0.33	0.30	0.30	0.36	0.51	0.43	0.43
IQ-Curr2	**0.94**	0.47	0.51	0.48	0.29	0.29	0.32	0.32	0.37	0.48	0.43	0.44
IQ-Curr3	**0.90**	0.49	0.50	0.49	0.40	0.38	0.38	0.37	0.43	0.49	0.43	0.48
IQ-Form1	0.51	**0.94**	0.57	0.76	0.32	0.25	0.30	0.31	0.68	0.66	0.34	0.39
IQ-Form2	0.45	**0.95**	0.59	0.76	0.34	0.29	0.29	0.31	0.70	0.64	0.35	0.39
IQ-Form3	0.46	**0.90**	0.53	0.73	0.34	0.29	0.33	0.38	0.68	0.57	0.38	0.36
IQ-Rele1	0.52	0.53	**0.89**	0.53	0.25	0.26	0.21	0.25	0.52	0.48	0.38	0.40
IQ-Rele2	0.47	0.49	**0.91**	0.48	0.28	0.27	0.20	0.25	0.43	0.46	0.35	0.39
IQ-Rele3	0.43	0.58	**0.85**	0.51	0.25	0.23	0.24	0.27	0.52	0.49	0.26	0.42
IQ-Unde1	0.51	0.73	0.52	**0.91**	0.35	0.35	0.33	0.34	0.60	0.51	0.41	0.39
IQ-Unde2	0.44	0.74	0.52	**0.93**	0.37	0.34	0.30	0.32	0.71	0.55	0.40	0.40
IQ-Unde3	0.46	0.74	0.52	**0.90**	0.33	0.33	0.32	0.35	0.70	0.58	0.41	0.37
SerQ-Assu1	0.29	0.35	0.23	0.35	**0.89**	0.71	0.73	0.77	0.36	0.33	0.23	0.33
SerQ-Assu2	0.30	0.22	0.16	0.25	**0.87**	0.71	0.59	0.68	0.24	0.21	0.19	0.30
SerQ-Assu3	0.39	0.36	0.37	0.39	**0.82**	0.68	0.58	0.61	0.36	0.35	0.26	0.42
SerQ-Empa1	0.32	0.27	0.27	0.35	0.71	**0.89**	0.56	0.66	0.29	0.29	0.25	0.31
SerQ-Empa2	0.28	0.21	0.19	0.26	0.69	**0.89**	0.53	0.64	0.25	0.26	0.16	0.24

Table 3.2 – *Continued*

SerQ-Empa3	0.33	0.26	0.23	0.31	0.75	**0.87**	0.60	0.70	0.30	0.32	0.22	0.30
SerQ-Empa4	0.34	0.31	0.32	0.40	0.71	**0.87**	0.61	0.66	0.38	0.35	0.28	0.39
SerQ-Reli1	0.35	0.33	0.23	0.34	0.66	0.59	**0.94**	0.75	0.32	0.30	0.27	0.35
SerQ-Reli2	0.32	0.31	0.23	0.33	0.73	0.66	**0.94**	0.78	0.34	0.31	0.28	0.38
SerQ-Reli3	0.35	0.30	0.25	0.31	0.70	0.62	**0.95**	0.80	0.33	0.30	0.26	0.38
SerQ-Resp1	0.30	0.34	0.25	0.32	0.70	0.62	0.84	**0.87**	0.34	0.32	0.26	0.35
SerQ-Resp2	0.36	0.30	0.26	0.35	0.75	0.74	0.67	**0.89**	0.27	0.29	0.25	0.30
SerQ-Resp3	0.29	0.30	0.25	0.31	0.66	0.63	0.65	**0.87**	0.28	0.34	0.21	0.28
SysQ-EOU2	0.28	0.52	0.46	0.54	0.26	0.26	0.26	0.23	**0.81**	0.50	0.27	0.36
SysQ-EOU3	0.34	0.66	0.51	0.64	0.26	0.28	0.26	0.29	**0.87**	0.59	0.29	0.38
SysQ-EOU4	0.39	0.65	0.51	0.62	0.30	0.31	0.25	0.27	**0.85**	0.68	0.35	0.43
SysQ-EOU5	0.33	0.57	0.39	0.57	0.32	0.27	0.29	0.28	**0.78**	0.53	0.34	0.42
SysQ-EOU6	0.42	0.69	0.50	0.69	0.36	0.33	0.31	0.31	**0.87**	0.63	0.40	0.46
SysQ-EOU7	0.40	0.68	0.50	0.69	0.38	0.34	0.36	0.34	**0.91**	0.63	0.40	0.47
SysQ-EOU8	0.35	0.64	0.47	0.65	0.36	0.28	0.36	0.34	**0.90**	0.61	0.33	0.46
SysQ-Flex1	0.50	0.54	0.45	0.45	0.24	0.22	0.25	0.28	0.50	**0.87**	0.36	0.41
SysQ-Flex2	0.47	0.53	0.43	0.48	0.31	0.32	0.30	0.34	0.53	**0.90**	0.31	0.40
SysQ-Flex3	0.44	0.67	0.52	0.62	0.34	0.35	0.29	0.32	0.76	**0.85**	0.37	0.45
SysQ-Reli1	0.39	0.26	0.33	0.34	0.23	0.25	0.24	0.22	0.31	0.30	**0.88**	0.50
SysQ-Reli2	0.46	0.39	0.35	0.46	0.27	0.26	0.28	0.27	0.40	0.41	**0.95**	0.55
SysQ-Reli3	0.44	0.39	0.34	0.42	0.23	0.21	0.27	0.26	0.38	0.38	**0.92**	0.54
SysQ-Resp1	0.48	0.39	0.48	0.42	0.38	0.33	0.32	0.31	0.48	0.45	0.51	**0.93**
SysQ-Resp2	0.48	0.41	0.41	0.42	0.40	0.33	0.38	0.36	0.47	0.48	0.57	**0.95**
SysQ-Resp3	0.42	0.36	0.40	0.36	0.37	0.34	0.38	0.33	0.46	0.43	0.55	**0.94**

IQCU: Information Quality – Currency
IQRE: Information Quality – Relevance
RQAS: Service Quality – Assurance
RQRL: Service Quality – Reliability
SQEU: System Quality – Ease of Use
SQRL: System Quality – Reliability

IQFO: Information Quality – Format
IQUN: Information Quality – Understandability
RQEM: Service Quality – Empathy
RQRP: Service Quality – Responsiveness
SQFL: System Quality – Flexibility
SQRP: System Quality – Response Time

Table 3.3 Correlation Matrix and Composite Reliability for Principal Constructs

	CR	Mean	SD	UCI	CF	EFC	EFI	FC	HA	IQAC	IQCO	IQCU	IQFO
UCI	0.92	4.54	1.89	**0.89**									
CF	0.92	4.42	1.37	0.68	**0.89**								
EFC	0.93	4.89	1.54	0.56	0.61	**0.91**							
EFI	0.95	5.17	1.50	0.64	0.70	0.83	**0.93**						
FC	0.95	5.46	1.32	0.37	0.42	0.41	0.50	**0.95**					
HA	0.94	4.95	1.58	0.60	0.64	0.64	0.69	0.55	**0.92**				
IQAC	0.92	4.58	1.41	0.41	0.48	0.32	0.40	0.14	0.26	**0.90**			
IQCO	0.94	4.68	1.52	0.49	0.60	0.39	0.44	0.15	0.36	0.61	**0.91**		
IQCU	0.94	4.82	1.49	0.40	0.44	0.38	0.39	0.13	0.31	0.67	0.59	**0.92**	
IQFO	0.95	4.56	1.65	0.57	0.55	0.33	0.42	0.19	0.36	0.56	0.69	0.51	**0.93**
IQRE	0.92	5.12	1.34	0.48	0.58	0.48	0.52	0.26	0.44	0.52	0.69	0.54	0.61
IQUN	0.94	4.64	1.49	0.53	0.54	0.37	0.45	0.28	0.40	0.62	0.62	0.52	0.81
RF	0.93	3.84	1.73	0.48	0.49	0.58	0.49	0.26	0.42	0.28	0.33	0.30	0.33
SA	0.97	4.30	1.59	0.77	0.77	0.56	0.61	0.36	0.54	0.51	0.58	0.51	0.63
SDF	0.95	3.98	1.78	0.52	0.55	0.56	0.49	0.25	0.37	0.29	0.39	0.33	0.37
RQAS	0.89	4.67	1.46	0.25	0.36	0.27	0.29	0.13	0.23	0.36	0.34	0.38	0.36
RQEM	0.93	4.62	1.42	0.27	0.35	0.27	0.30	0.20	0.25	0.34	0.31	0.36	0.30
RQRL	0.96	4.36	1.51	0.28	0.33	0.23	0.27	0.09	0.20	0.35	0.30	0.36	0.33
RQRP	0.91	4.44	1.52	0.31	0.36	0.25	0.27	0.13	0.22	0.32	0.31	0.36	0.36
SQEU	0.95	4.36	1.62	0.55	0.57	0.35	0.44	0.34	0.48	0.45	0.58	0.42	0.74
SQFL	0.91	4.35	1.62	0.50	0.54	0.35	0.38	0.21	0.33	0.52	0.59	0.54	0.67
SQRL	0.94	4.86	1.46	0.42	0.46	0.33	0.36	0.21	0.31	0.46	0.35	0.47	0.38
SQRP	0.96	4.51	1.48	0.36	0.45	0.30	0.33	0.19	0.31	0.50	0.42	0.49	0.41

Diagonal elements (Bolded) in the correlation matrix are square root of AVE scores.

CR: Composite Reliability SD: Standard Deviation
UCI: Use Continuance Intention CF: IS Use Confirmation EFC: Perceived Effectiveness
EFI: Perceived Efficiency RF: Relatedness Fulfillment SDF: Self-Development Fulfillment
SA: IS User Satisfaction HA: Habit FC: Facilitating Conditions
IQAC: Information Quality – Accuracy IQCO: Information Quality – Completeness
IQCU: Information Quality – Currency IQFO: Information Quality – Format
IQRE: Information Quality – Relevance IQUN: Information Quality – Understandability
RQAS: Service Quality – Assurance RQEM: Service Quality – Empathy
RQRL: Service Quality – Reliability RQRP: Service Quality – Responsiveness
SQEU: System Quality – Ease of Use SQFL: System Quality – Flexibility
SQRL: System Quality – Reliability SQRP: System Quality – Response Time

	IQRE	IQUN	RF	SA	SDF	RQAS	RQEM	RQRL	RQRP	SQEU	SQFL	SQRL	SQRP
UCI													
CF													
EFC													
EFI													
FC													
HA													
IQAC													
IQCO													
IQCU													
IQFO													
IQRE	**0.89**												

Table 3.3 – *Continued*

IQUN	0.57	**0.91**											
RF	0.37	0.30	**0.91**										
SA	0.57	0.58	0.48	**0.94**									
SDF	0.37	0.28	0.80	0.54	**0.92**								
RQAS	0.29	0.38	0.22	0.34	0.22	**0.86**							
RQEM	0.29	0.37	0.19	0.29	0.21	0.81	**0.88**						
RQRL	0.25	0.35	0.09	0.31	0.20	0.74	0.66	**0.95**					
RQRP	0.29	0.37	0.17	0.35	0.24	0.80	0.76	0.82	**0.88**				
SQEU	0.56	0.73	0.31	0.61	0.31	0.37	0.35	0.35	0.34	**0.86**			
SQFL	0.54	0.60	0.34	0.58	0.39	0.35	0.35	0.32	0.36	0.70	**0.87**		
SQRL	0.37	0.45	0.23	0.44	0.23	0.27	0.26	0.29	0.27	0.40	0.40	**0.92**	
SQRP	0.46	0.43	0.23	0.46	0.26	0.41	0.35	0.39	0.35	0.50	0.48	0.58	**0.94**

Diagonal elements (Bolded) in the correlation matrix are square root of AVE scores.

CR: Composite Reliability; SD: Standard Deviation;
UCI: Use Continuance Intention; CF: IS Use Confirmation; EFC: Perceived Effectiveness;
EFI: Perceived Efficiency; RF: Relatedness Fulfillment; SDF: Self-Development Fulfillment;
SA: IS User Satisfaction; HA: Habit; FC: Facilitating Conditions;
IQAC: Information Quality – Accuracy; IQCO: Information Quality – Completeness;
IQCU: Information Quality – Currency; IQFO: Information Quality – Format;
IQRE: Information Quality – Relevance; IQUN: Information Quality – Understandability;
RQAS: Service Quality – Assurance; RQEM: Service Quality – Empathy;
RQRL: Service Quality – Reliability; RQRP: Service Quality – Responsiveness;
SQEU: System Quality – Ease of Use; SQFL: System Quality – Flexibility;
SQRL: System Quality – Reliability; SQRP: System Quality – Response Time;

3.9 Research Results

3.9.1 Structural Model

The relationships between latent variables are described in the structural model (or inner model) of the PLS (Chin and Newsted, 1999). To determine the significance of the model relationships, t-values are calculated using bootstrapping method based on 300 resampling iterations. The outcomes of the PLS structural model are presented in Figure 3.6 (for quality constructs) and Figure 3.7 (for main model). Almost all relationships are highly significant ($p<0.01$), the two exceptions are IS Use Continuance Intention to System Use (Insignificant) and Satisfaction to Habit (Significant at $p<0.05$). The values of R^2 are quite high: the range is from 0.474 (Confirmation) to 0.632 (Continuance Intention) except System Use (0.248) and Facilitating Condition (0.024).

It was found that the IS Use Continuance Intention is not significantly related to System Use. This is likely due to the existence of Habit. It appears that with Habit in the model, the predictive power of Continuance Intention diminishes. This result is readily interpretable since habit can be expected to dominate after an extended period of system use. Thus, one may proceed to obtain a trimmed model by removing the construct of IS Use Continuance Intention, as in Figure 3.8. The R^2 for Habit and System Use increased to 0.553 and 0.250, respectively. The rest of the model remains the same.

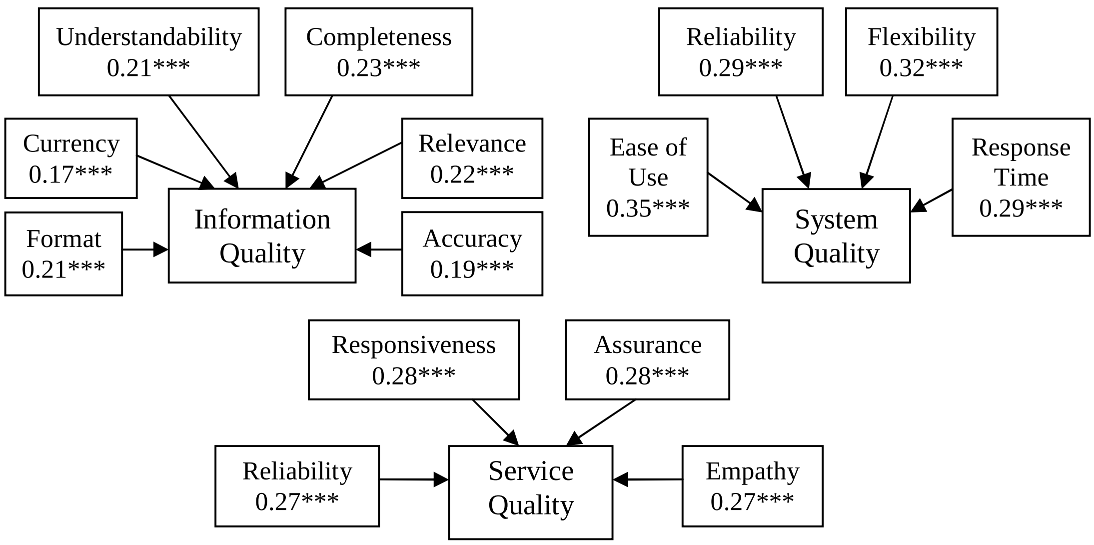

Figure 3.6 PLS Structural Model Output (Quality Constructs)

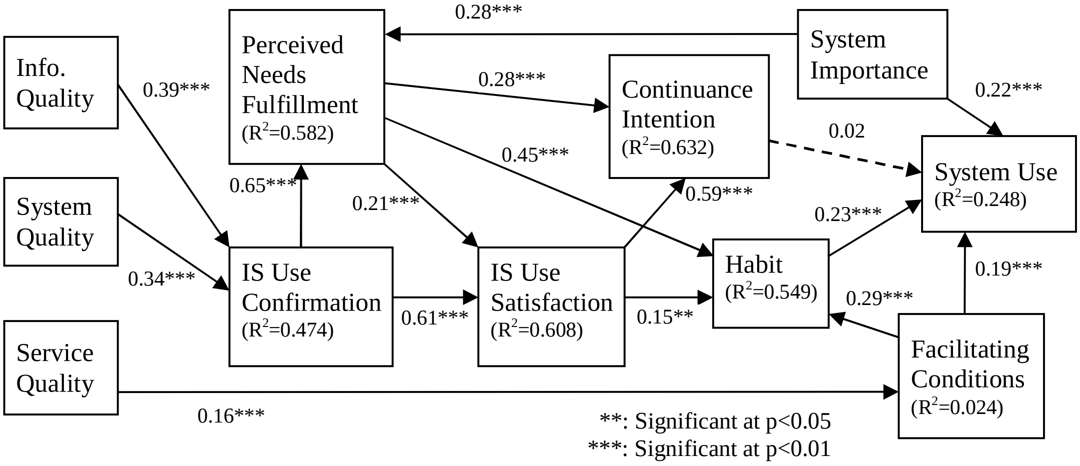

Figure 3.7: PLS Structural Model Output (Proposed Model)

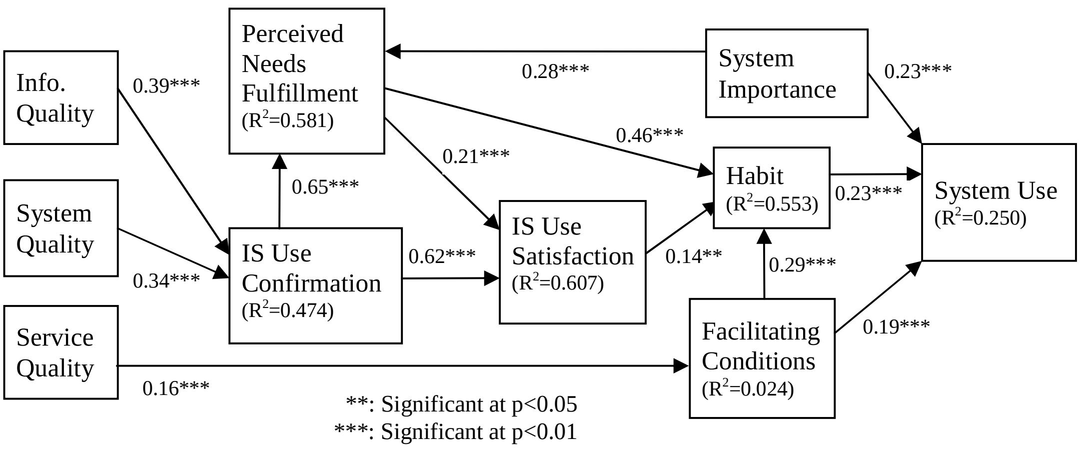

Figure 3.8: PLS Structural Model Output (Trimmed Model)

3.9.2 Hypotheses Testing

For the proposed model (Figure 3.7), results for hypotheses testing are summarized in Table 3.4. As can be seen, all hypotheses are supported by the outcome of the structural model with the only exception of H11. Moreover, it should be noted that the removal of Use Continuance Intention from the model also dictates the removal of H6, H9, and H11 in the trimmed model. However, all the remaining hypotheses are strongly supported in the trimmed model (see Figure 3.8).

Table 3.4 Summary of Hypothesis Testing

Hypothesis	**Relationship**	**Result**
H1	Information Quality – IS Use Confirmation	Supported
H2	System Quality – IS Use Confirmation	Supported
H3	Service Quality – Facilitating Conditions	Supported
H4	IS Use Confirmation - Perceived Needs Fulfillment	Supported
H5	IS Use Confirmation – IS User Satisfaction	Supported
H6*	Perceived Needs Fulfillment - Use Continuance Intention	Supported
H7	Perceived Needs Fulfillment – IS User Satisfaction	Supported
H8	IS User Satisfaction – Habit	Supported
H9*	IS User Satisfaction - Use Continuance Intention	Supported
H10	Perceived Needs Fulfillment – Habit	Supported
H11*	Use Continuance Intention – System Use	Not Supported
H12	Habit – System Use	Supported
H13	Facilitating Conditions – Habit	Supported
H14	Facilitating Conditions - System Use	Supported

* Not included in the trimmed IS Success Model

3.10 Discussion and Conclusion

3.10.1 Discussion

The IS Use Confirmation, with its two antecedent factors (Perceived Information Quality and System Quality), are able to predict most of the success measure with high precision. As can be seen in Figure 3.8, the R^2 for these measures are high: 61% for Satisfaction, 58% for Perceived Needs Fulfillment, and 55% for Habit. In fact, if two direct links are added from Information and System Quality to Needs Fulfillment, both links turned out to be insignificant, indicating that the Confirmation variable totally mediated the relationships between the two quality variables (Information and System Quality) and Satisfaction. Thus, the Confirmation step in the minds of the IS users does appear to succeed in processing the quality perceptions gathered from their experience in utilizing the information provided and using the system. This paints a picture of what is happening to an information system when it reaches an "equilibrium" state after an extended period of use in an organization.

The role of Facilitating Condition in this model is mainly demonstrated in its significant impact on habit (beta = 0.29). Facilitating Condition is an external facilitator; when compared to the large impact of Needs Fulfillment (beta = 0.46), which is more internal and substantive for habit formation, the lesser magnitude of its impact on habit is in line with our expectation.

The R^2 for Satisfaction is high (0.607), indicating that this success model has captured the most essential and important factors that are responsible for forming user's satisfaction. As shown in Figure 3.8, the influence on Satisfaction is coming directly from Confirmation, as well as indirectly from Confirmation mediated through Needs Fulfillment. Here, the significant results have demonstrated the validity and power of the EDT theory.

After using an information system for an extended period of time, the extent that a user has developed a habit in using the system is certainly an excellent measure for the system's success. This study's results, as shown in Figure 3.8, indicate that a major portion of variation in this vital success measure (R^2 = 0.553) can be explained by Needs Fulfillment directly (beta = 0.46) and indirectly (beta = 0.14) through Satisfaction. Here, the direct impact appears to dominate, and one can appreciate how habit is formed and reinforced by the real and substantive benefits of a system, i.e., Needs Fulfillment. Users will use the system in a more "automated" fashion if the system offers better benefits in terms of Needs Fulfillment and vice versa.

This study has revealed an interesting and intriguing role of Habit after the system has been used for an extended period of time. Among the links in the proposed model, the author included both Use Continuance Intention as well as Habit, between Satisfaction and Systems use. It was found, however, that the impact of Intention on System Use is nonexistent. It appears that after an extended period of use, explicit cognitive estimation on continuance intention will no longer be a reliable predictor of actual system use. Instead, the extent of usage behavior automation without conscious thoughts takes over and becomes a significant predictor of system use.

The final “downstream” dependent variable, System Use, shows a R^2 value at 0.25, indicating a moderate proportion of its variation can be accounted for by System Importance, Habit, and Facilitating Condition. Depending on the nature of the system, business routine may dictate its use on a daily basis or even constantly, while others may be used monthly or occasionally. While other success measures in this model are not related to this source of variation, the System Use variable is. This result is thus consistent with expectations since the sample contains a wide variety of systems.

Finally, the variance of the Facilitating Condition variable is accounted for by Service Quality at a limited level (0.024). This result might be due to the fact that Facilitating Condition contains multiple factors which are beyond the service of IT department. In fact, the major components of the scale for Facilitating Condition are related to the resource and knowledge necessary to use the system, and these may not be directly included in the service from the IT department. In general, external factors such as Service Quality and Facilitating Condition become less important after an extended period of system use, and results are similar to previous findings (Agarwal and Prasad, 1997).

3.10.2 Contribution to Research and Practice

The IS success model proposed and refined by DeLone and McLean (1992; 2003) captured the important factors for IS success and posit how these factors are related. The proposed model is based on the same set of seven factors: Quality of Information, Quality of Systems, Service Quality, Use Intention (Use Continuance Intention for this study), System Use, User Satisfaction, and Net Benefits (Need Fulfillment for the current study). However, this study incorporates further theoretical advances in recent years, including Bhattacherjee's use continuance model (2001), with the EDT theory built in, and the addition of the habit factor (Limayam et al., 2007) which becomes more critical as the usage time increases.

Built upon the foundation of DeLone and McLean's seminal work on IS Success (1992, 2003), and enriched with recent theoretical advances (Bhattacherjee, 2001; Limayem et al., 2007), the author has made a significant contribution in proposing and validating a theoretically integrated model of IS success that has captured the most salient factors and measures of IS success: Needs Fulfillment, Satisfaction, Habit, and System Use. Further, this study has empirically validated the model which results in high R-squares, indicating that the hypothesized relationships, which emanates from users' confirmation of the system, have successfully depicted how the various factors are "configured" to constitute an overall "macro" picture of IS success. Thus, this work has significantly moved forward the research in IS success by building upon and expanding from the cumulative research in this vital area.

The model of IS Success in this study would assist practitioners in two ways. First, the author has provided a range of validated measures for IS success, including Information Quality, System Quality, Service Quality, Use Confirmation, Needs Fulfillment, User Satisfaction, Habit, Facilitating Condition, and System Use. These scales can be fruitfully used by practitioners to gauge various aspects of system success after its implementation. Second, the model which has established relationships between these measures holds great promise as a diagnostic tool for identifying and isolating IS implementation problems.

3.10.3 Limitations and Future Studies

This study was conducted in a cross-sectional manner, i.e., all data were collected at the same time in one questionnaire. Thus, inferring causal relationships from research results should be done with caution. Further, common method bias (CMB) might inflate the relationship coefficients (Podsakoff and Organ, 1986). However, one argues that the CMB does not threaten the findings of this research based on three reasons. First, IS studies are focused on IT artifacts and more “concrete” types of constructs, so subjects are less likely to respond with social sensitivity concerns (Malhotra, Kim, and Patil, 2006). Second, the author uses several methods recommended by

Podsakoff, MacKenzie, Lee, and Podsakoff (2003) to minimize the occurrence of CMB. These techniques include: (1) properly arrange survey items to achieve proximity, psychological, and methodological separations, and (2) announce that the respondent's identity will be protected to ensure respondent anonymity, and (3) emphasize that there is no right or wrong answers for the survey questions to reduce evaluation apprehension. Third and last, two methods suggested by Podsakoff et al. (2003) and Liang, Saraf, Hu, and Xue (2007) are used to examine the potential CMB in this research. The first method, Harman's one factor test, examines CMB using exploratory factor analysis. The second method sets up a virtual "method" construct in the PLS structural model and checks the common variance this construct can explain. Both methods report satisfactory results that this study was not contaminated by the CMB. However, conducting research with a longitudinal design in the future is still recommended. Such future studies can further enhance the causal inferences of the model and reduce the threat of CMB.

Some scholars challenge the generalizability of the research conclusions which are based on educational settings (Agarwal and Prasad, 1997). Yet, the author has indicated in earlier sections that the student samples reached was populated by business professionals who utilize information systems in various organizations and industries. Thus, it is argued that the findings of our research can be readily applied to organizational settings. In the mean time, one is aware that many emerging IS research domains, such as E-commerce and social computing, are not theoretically confined within an organization or a business. Therefore, the possible future studies may be grounded in contexts beyond both the educational settings and the conventional business environments. Such multi-domain examinations can further enhance the generalizability and robustness of the model as proposed in this research.

This research model is based on the IS success model developed by DeLone and McLean (1992, 2003), with theoretical infusion from the EDT theory and the work of Bhattacherjee (2001) and Limayam et al., (2007). Future studies may explore other theoretical underpinnings for IS success. For example, the various IS quality measures may be conceived as different product attributes, and locations of specific IS in the product space (Ratchford,1990; Johnson,1971) may be associated with systems user satisfaction and perceived benefits.

APPENDIX A

CONSTRUCT ITEMS

Anchors for all constructs are 1 to 7 (1 = Strongly Disagree; 7 = Strongly Agree) except System Use (Duration, Frequency, and Intensity/Depth) and Quality (Information Quality, System Quality, and Service Quality) constructs.

Perceived Effectiveness

Effecti1: Using System S improves my job performance. (Davis, 1989)

Effecti2: Using System S enables me to do more important things that are not possible without the system.

Effecti3: Using System S helps me to focus more on the ultimate goals and objectives of my job.

Effecti4: Using System S enhances my overall effectiveness on the job. (Davis, 1989)

Perceive Efficiency (adopted from Davis, 1989)

Efficien1: Using System S in my job enables me to accomplish tasks more quickly.

Efficien2: I find System S useful in my job.

Efficien3: Using System S in my job increases my productivity.

Efficien4: Using Systems S makes it easier to do my job.

Perceived Relatedness Fulfillment (adopted from Au et al.. 2008)

RelatNF1: Using System S enables me to get more recognition from colleagues and customers at work.

RelatNF2: Using System S enables me to establish better relationships and communications with colleagues and customers at work.

RelatNF3: Using System S enables me to have more influence over colleagues at work.

Perceived Self-Development Fulfillment (adopted from Au et al., 2008)

SelfDNF1: Using System S enables me to experience personal growth through better decision making.

SelfDNF2: Using System S poses new challenges at work and provides opportunities to advance my career.

SelfDNF3: Using System S helps me to further develop my expertise and enhance my professional qualifications

IS Use Confirmation (adopted from Bhattacherjee, 2001)

Confirm1: My experience with using System S was better than what I expected.

Confirm2: The service level provided by System S was better than what I expected.

Confirm3: Overall, most of my expectations from using System S were confirmed.

IS Satisfaction (adapted from Au et al., 2008; Briggs et al., 2008; Bhattacherjee, 2001)

Satisf1: I am content with System S.

Satisf2: I am pleased with System S.

Satisf3: I have a positive feeling toward System S.

Satisf4: I feel happy with System S.

Satisf5: I feel delighted with System S.

Satisf6: Overall, I am satisfied with System S.

IS Continuance Intention (adopted from Bhattacherjee, 2001)

CUseInten1: If I have a choice, I would like to continue using System S rather than discontinue its use.

CUseInten2: If I can choose, my intentions are to continue using System S than use alternative solutions.

CUseInten3: If I could, I would like to discontinue my use of System S

Facilitating Conditions (adopted from Venkatesh et al., 2008)

FaciCond1: I have the resources necessary to use System S

FaciCond2: I have the knowledge necessary to use System S

FaciCond3: System S is not compatible with other systems I use

FaciCond4: A specific person (or group) is available for assistance with difficulties of System S

Habit (adopted from Limayem et al., 2007)

Habit1: Using System S has become automatic to me

Habit2: Using System S is natural to me

Habit3: When faced with a particular task, using System S is an obvious choice for me

System Use – Duration (adapted from Venkatesh et al., 2008)

On average, I use System S _____ hours per week (please estimate).

System Use – Frequency

On average, I use System S _______ times per week (please estimate).

System Use – Intensity/Depth

Please rate the depth of your using System S (i.e., using more complex and advanced features of the system) 1: Minimum depth   7: Maximun depth

Information Quality (Anchor: 1 = Much lower than I expected; 7 = Much higher than I expected)

Relevance (adapted from Lee et al., 2002; Gable et al., 2008)

IQRele1: System S provides a set of information relevant to my work

IQRele2: System S produces the information that is required for my work

IQRele3: System S provides output that seems to be exactly what is needed to do my work

Completeness (adapted from Nelson et al., 2005; Lee et al., 2002)

IQComp1: Information provided by System S is complete

IQComp2: Information provided by System S is comprehensive

IQComp3: Information provided by System S is thorough

Format (adapted from Nelson et al., 2005; Gable et al., 2008)

IQForm1: Information provided by System S is well formatted

IQForm2: Information provided by System S is well laid out

IQForm3: Information provided by System S is clearly presented on the screen

Currency (adapted from Nelson et al., 2005; Lee et al., 2002)

IQCurr1: System S provides the latest and newest information

IQCurr2: System S produces the most current information

IQCurr3: Information from System S is always up to date

Accuracy (adapted from Nelson et al., 2005; Gable et al., 2008)

IQAccu1: System S produces correct information

IQAccu2: There are no errors in the information obtained from System S

IQAccu3: Information provided by System S is accurate

Understandability (adapted from McKinney et al., 2002; Lee et al., 2002; Gable et al., 2008)

IQUnde1: Information from System S is clear in meaning

IQUnde2: Information from System S is easy to comprehend

IQUnde3: Information from System S is easy to read

System Quality (Anchor: 1 = Much lower than I expected; 7 = Much higher than I expected)

Reliability (adapted from Nelson et al., 2005; Gable et al., 2008)

SysQReli1: System S has satisfactory up time, with tolerable down time.

SysQReli2: System S performs reliably

SysQReli3: The operation of System S is dependable

Flexibility (adapted from Nelson et al., 2005; Gable et al., 2008)

SysQFlex1: System S can be adapted to meet a variety of needs

SysQFlex2: System S can be flexibly adjusted to new demands or conditions

SysQFlex3: It is easy for users to get System S to do what they want to do

Ease of Use (adapted from Davis, 1989; McKinney et al., 2002; Gable et al., 2008)

SysQEOU1: It is easy to get into Systems S

SysQEOU2: It is easy to become skillful at using Systems S

SysQEOU3: System S is easy to navigate

SysQEOU4: System S is flexible to interact with

SysQEOU5: System S requires only the minimum number of fields and screens to achieve a task

SysQEOU6: Interactions with System S are clear and understandable

SysQEOU7: In general, System S is easy to use

SysQEOU8: Learning to use System S is easy

Response Time (adapted from McKinney et al., 2002; Nelson et al., 2005)

SysQResp1: System S fulfills users' requests instantaneously

SysQResp2: System S responds to users' demands without delay

SysQResp3: System S returns answers to requests quickly

Service Quality (Anchor: 1 = Much lower than I expected; 7 = Much higher than I expected)

Reliability (adopted from SERVPERF by Jiang et al., 2002)

SerQReli1: When IT department promises to do something by a certain time, it does so

SerQReli2: IT department is dependable

SerQReli3: IT department provides its services at the time it promises to do so

Responsiveness (adopted from SERVPERF by Jiang et al., 2002)

SerQResp1: IT employees give prompt service to users

SerQResp2: IT employees are always willing to help users

SerQResp3: IT employees are never too busy to respond to users' requests

Assurance (adopted from SERVPERF by Jiang et al., 2002)

SerQAssu1: The behavior of IT employees instills confidence in users

SerQAssu2: IT employees are consistently courteous with users

SerQAssu3: IT employees have the knowledge to do their job well

Empathy (adopted from SERVPERF by Jiang et al., 2002)

SerQEmpa1: IT department gives users individual attention

SerQEmpa2: IT department has employees who give users personal attention

SerQEmpa3: IT department has the users' best interest at heart

SerQEmpa4: Employees of IT department understand the specific needs of its users

REFERENCES

Aarts, H., Verplanken, B., & Van Knippenberg, A. (1998). Predicting behavior from actions in the past: Repeated decision making or a matter or habit? *Journal of Applied Social Psychology, 28*(15), 1355-1374.

Adams, D. A., Nelson, R. R., & Todd, P. A. (1992). Perceived usefulness, ease of use, and usage of information technology: A replication. *MIS Quarterly, 16*(2), 227-247.

Agarwal, R., & Karahanna, E. (2000). Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage. *MIS Quarterly, 24*(4), 665-694.

Agarwal, R., & Prasad, J. (1997). The role of innovation characteristics and perceived voluntariness in the acceptance of information technologies. *Decision Sciences, 28*(3), 557-582.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior & Human Decision Processes, 50*(2), 179.

Alderfer, C. P. (1969). An empirical test of a new theory of human needs. *Organizational Behavior & Human Performance, 4*(2), 142-175.

Alter, S. (1999). *Information systems: A management perspective*. New York: Addison Wesley.

Anderson, E. W., & Sullivan, M. W. (1993). The antecedents and consequences of customer satisfaction for firms. *Marketing Science, 12*(2), 125-143.

Au, N., Ngai, E. W. T., & Cheng, T. C. E. (2008). Extending the understanding of end user information systems satisfaction formation: An equitable needs fulfillment model approach. *MIS Quarterly, 32*(1), 43-66.

Au, N., Ngai, E. W. T., & Cheng, T. C. E. (2002). A critical review of end-user information system satisfaction research and a new research framework. *Omega, 30*(6), 451.

Babakus, E., & Boller, G. W. (1992). An empirical assessment of the SERVQUAL scale. *Journal of Business Research, 24*(3), 253-268.

Bagozzi, R. P. (2007). The legacy of the technology acceptance model and a proposal for a paradigm shift. *Journal of the Association for Information Systems, 8*(4), 244-254.

Bailey, J. E., & Pearson, S. W. (1983). Development of a tool for measuring and analyzing computer user satisfaction. *Management Science, 29*(5), 530-545.

Ballou, D. P., & Pazer, H. L. (1985). Modeling data and process quality in multi-input, multi-output information systems. *Management Science, 31*(2), 150-162.

Ballou, D., Madnick, S., & Wang, R. (2003). Special section: Assuring information quality. *Journal of Management Information Systems, 20*(3), 9-11.

Baroudi, J. J., & Orlikowski, W. J. (1988). A short-from measure of user information satisfaction: A psychometric evaluation and notes on use. *Journal of Management Information Systems, 4*(4), 44-59.

Benbasat, I., & Barki, H. (2007). Quo vadis, TAM? *Journal of the Association for Information Systems, 8*(4), 212-218.

Bhattacherjee, A. (2001). Understanding information systems continuance: An expectation-confirmation model. *MIS Quarterly, 25*(3), 351-370.

Bhattacherjee, A., & Premkumar, G. (2004). Understanding changes in belief and attitude toward information tech- nology usage: A theoretical model and longitudinal test. *MIS Quarterly, 28*(2), 229-254.

Brady, M. K., Cronin, J. J., & Brand, R. R. (2002). Performance-only measurement of service quality: A replication and extension. *Journal of Business Research, 55*(1), 17-31.

Briggs, R. O., Reinig, B. A., & de Vreede, G. (2008). The yield shift theory of satisfaction and its application to the IS/IT domain. *Journal of the Association for Information Systems, 9*(5), 267-293.

Brynjolfsson, E., Malone, T. W., Gurbaxani, V., & Kambil, A. (1994). Does information technology lead to smaller firms? *Management Science, 40*(12), 1628-1644.

Burton-Jones, A., & Straub, D. W. (2006). Reconceptualizing system usage: An approach and empirical test. *Information Systems Research, 17*(3), 228-246.

Burton-Jones, A., & Gallivan, M. J. (2007). Toward a deeper understanding of system usage in organizations: A multilevel perspective. *MIS Quarterly, 31*(4), 657-679.

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin, 56*(2), 81-105.

Carr, N. G. (2003). IT doesn't matter. *Harvard Business Review, 81*(5), 41-49.

Chin, W. W. (1998). The partial least squares approach for structural equation modeling. In G. A. Marcoulides (Ed.), *Modern methods for business research* (pp. 295-336). Hillsdale, NJ: Lawrence Erlbaum Associates.

Chin, W. W., & Gopal, A. (1995). Adoption intention in GSS: Relative importance of beliefs. *DATABASE for Advances in Information Systems, 26*(2&3), 42-64.

Chin, W. W., & Newsted, P. R. (1999). Structural equation modeling analysis with small samples using partial least squares. In R. H. Hoyle (Ed.), *Statistical strategies for small sample research* (). Thousand Oaks, California: Sage Publications.

Compeau, D. R., & Higgins, C. A. (1995). Computer self-efficacy: Development of a measure and initial test. *MIS Quarterly, 19*(2), 189-211.

Compeau, D., Higgins, C. A., & Huff, S. (1999). Social cognitive theory and individual reactions to computing technology: A longitudinal study. *MIS Quarterly, 23*(2), 145-158.

Cote, J. A., & Buckley, M. R. (1987). Estimating trait, method, and error variance: Generalizing across 70 construct validation studies. *Journal of Marketing Research (JMR), 24*(3), 315-318.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of Applied Social Psychology, 22*(14), 1111-1132.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-340.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*(8), 982-1003.

DeLone, W. H. (1988). Determinants of success for computer usage in small business. *MIS Quarterly, 12*(1), 51-61.

DeLone, W. H., & McLean, E. R. (1992). Information systems success: The quest for the dependent variable. *Information Systems Research, 3*(1), 60-95.

DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: A ten-year update. *Journal of Management Information Systems, 19*(4), 9-30.

Diamantopoulos, A., & Winklhofer, H. M. (2001). Index construction with formative indicators: An alternative to scale development. *Journal of Marketing Research (JMR), 38*(2), 269-277.

Doll, W. J., Deng, X., Raghunathan, T. S., Torkzadeh, G., & Xia, W. (2004). The meaning and measurement of user satisfaction: A multigroup invariance analysis of the end-user computing satisfaction instrument. *Journal of Management Information Systems, 21*(1), 227-262.

Doll, W. J., & Torkzadeh, G. (1988). The measurement of end-user computing satisfaction. *MIS Quarterly, 12*(2), 259-274.

Doll, W. J., & Torkzadeh, G. (1991). The measurement of end-user computing satisfaction: Theoretical and methodological issues. *MIS Quarterly, 15*(1), 5-10.

Doll, W. J., & Torkzadeh, G. (1998). Developing a multidimensional measure of system-use in an organizational context. *Information & Management, 33*(4), 171.

Doll, W. J., Xia, W., & Torkzadeh, G. (1994). A confirmatory factor analysis of the end-user computing satisfaction instrument. *MIS Quarterly, 18*(4), 453-461.

Drucker, P. F. (1967). *The effective executive*. New York: Harper & Row.

Drucker, P. F. (1985). *The effective executive*. New York: Harper & Row.

Eason, K. (1988). *Information technology and organizational change*. London: Taylor and Francis.

Fazio, R. H., & Zanna, M. P. (1981). Direct experience and attitude-behavior consistency. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (pp. 161-202). New York: Academic Press.

Feltham, G. A. (1968). The value of information. *Accounting Review, 43*(4), 684-696.

Festinger, L. A. (1957). *A theory of cognitive dissonance*. Evanston, IL: Row and Peterson.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.

Fornell, C., & Bookstein, F. L. (1982). Two structural equation models: LISREL and PLS applied to consumer exit-voice theory. *Journal of Marketing Research (JMR), 19*(4), 440-452.

Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of Marketing Research (JMR), 18*(3), 382-388.

Fruhling, A., & de Vreede, G. (2006). Field experiences with eXtreme programming: Developing an emergency response system. *Journal of Management Information Systems, 22*(4), 39-68.

Gable, G. G., Sedera, D., & Taizan Chan. (2008). Re-conceptualizing information system success: The IS-impact measurement model. *Journal of the Association for Information Systems, 9*(7), 1-32.

Gefen, D., & Straub, D. (2005). A practical guide to factorial validity using pls-graph: Tutorial and annotated example. *Communications of AIS, 2005*(16), 91-109.

Glassberg, B. C. (2000). Individual use of web technology: A reconceptualization and empirical test of the technology acceptance model. (Ph.D. Dissertation, University of South Carolina).

Goodhue, D. (1988). IS attitudes: Toward theoretical and definition clarity. *Data Base, 19*(3/4), 6-15.

Goodhue, D. L. (1995). Understanding user evaluations of information systems. *Management Science, 41*(12), 1827.

Goodhue, D. L. (2007). Comment on benbasat and barki's "quo vadis TAM" article. *Journal of the Association for Information Systems, 8*(4), 220-222.

Gregor, S. (2006). The nature of theory in information systems. *MIS Quarterly, 30*(3), 611-642.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis* (6th ed.). Upper Saddle River, New Jersey: Pearson Education, Inc.

Hartwick, J., & Barki, H. (1994). Explaining the role of user participation in information system use. *Management Science, 40*(4), 440-465.

Hirschheim, R. (2007). Introduction to the special issue on "quo vadis TAM -- issues and reflections on technology acceptance research". *Journal of the Association for Information Systems, 8*(4), 204-205.

Ives, B., Olson, M. H., & Baroudi, J. J. (1983). The measurement of user information satisfaction. *Communications of the ACM, 26*(10), 785-793.

James, W. (1890). *The principles of psychology*. New York: Henry Holt & Co.

Jasperson, J., Carter, P. E., & Zmud, R. W. (2005). A comprehensive conceptualization of post-adoptive behaviors associated with information technology enabled work systems. *MIS Quarterly, 29*(3), 525-557.

Jia, R., Reich, B. H., & Pearson, J. M. (2008). IT service climate: An extension to IT service quality research. *Journal of the Association for Information Systems, 9*(5), 294-320.

Jiang, J. J., Klein, G., & Carr, C. L. (2002). Measuring information system service quality: Servqual from the other side. *MIS Quarterly, 26*(2), 145-166.

Johnson, R. M. (1971). Market segmentation: A strategic management tool. *Journal of Marketing Research (JMR), 8*(1), 13-18.

Karahanna, E., Straub, D. W., & Chervany, N. L. (1999). Information technology adoption across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs. *MIS Quarterly, 23*(2), 183-213.

Keil, M., Mann, J., & Rai, A. (2000). Why software projects escalate: An empirical analysis and test of four theoretical models. *MIS Quarterly, 24*(4), 631-664.

Kettinger, W. J., & Lee, C. C. (1994). Perceived service quality and user satisfaction with the information services function. *Decision Sciences, 25*(5), 737-766.

Kettinger, W. J., & Lee, C. C. (1997). Pragmatic perspectives on the measurement of information systems service quality. *MIS Quarterly, 21*(2), 223-240.

Kettinger, W. J., & Lee, C. C. (2005). Zones of tolerance: Alternative scales for measuring information systems service quality. *MIS Quarterly, 29*(4), 607-623.

Landrum, H., Prybutok, V. R., & Zhang, X. (2007). A comparison of magal's service quality instrument with SERVPERF. *Information & Management, 44*(1), 104-113.

Lee, Y. W., Strong, D. M., Kahn, B. K., & Wang, R. Y. (2002). AIMQ: A methodology for information quality assessment. *Information & Management, 40*(2), 133.

Lee, Y., Kozar, K. A., & Larsen, K. R. T. (2003). The technology acceptance model: Past, present, and future. *Communications of the Association for Information Systems, 2003*(12), 752-780.

Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Information & Management, 40*(3), 191.

Liang, H., Saraf, N., Hu, Q., & Xue, Y. (2007). Assimilation of enterprise systems: The effect of institutional pressures and the mediating role of top management. *MIS Quarterly, 31*(1), 59-87.

Limayem, M., Hirt, S. G., & Cheung, C. M. K. (2007). How habit limits the predictive power of intention: The case of information systems continuance. *MIS Quarterly, 31*(4), 705-737.

Lucas Jr., H. C., Swanson, E. B., & Zmud, R. W. (2007). Implementation, innovation, and related themes over the years in information systems research. *Journal of the Association for Information Systems, 8*(4), 206-210.

Mahmood, A. M., Burn, J. M., Gemoets, L. A., & Jacquez, C. (2000). Variables affecting information technology end-user satisfaction: A meta-analysis of the empirical literature. *International Journal of Human-Computer Studies, 52*(4), 751-771.

Mahmood, M. O., & Becker, J. D. (1985). Effect of organizational maturity on end-users' satisfaction with information systems. *Journal of Management Information Systems, 2*(3), 37-64.

Malhotra, N. K., Kim, S. S., & Patil, A. (2006). Common method variance in IS research: A comparison of alternative approaches and a reanalysis of past research. *Management Science, 52*(12), 1865-1883.

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review, 50*, 370-396.

Mason, R. O. (1978). Measuring information output: A communication systems approach. *Information & Management, 1*(5), 219-234.

McKinney, V., Yoon, K., & Zahedi, F. (2002). The measurement of web-customer satisfaction: An expectation and disconfirmation approach. *Information Systems Research, 13*(3), 296-315.

Melone, N. P. (1990). A theoretical assessment of the user-satisfaction construct in information systems research. *Management Science, 36*(1), 76-91.

Melville, N., Kraemer, K., & Gurbaxani, V. (2004). Information technology and organizational performance: An integrative model of it business value. *MIS Quarterly, 28*(2), 283-322.

Moore, G. C., & Benbasat, I. (1991). Developing of an instrument to measure the perception of adopting an information technology innovation. *Information Systems Research, 2*(3), 192-222.

Nelson, R. R., Todd, P. A., & Wixom, B. H. (2005). Antecedents of information and system quality: An empirical examination within the context of data warehousing. *Journal of Management Information Systems, 21*(4), 199-235.

Oliver, R. L. (1997). *Satisfaction: A behavioral perspective on the consumer*. New York: McGraw-Hill.

Oliver, R. L. (1980). A cognitive model of the antecedents and consequences of satisfaction decisions. *Journal of Marketing Research (JMR), 17*(4), 460-469.

Oliver, R. L. (1995). Attribute need fulfillment in product usage satisfaction. *Psychology & Marketing, 12*(1), 1-17.

Orbell, S., Blair, C., Sherlock, K., & Conner, M. (2001). The theory of planned behavior and ecstasy use: Roles for habit and perceived control over taking versus obtaining substances. *Journal of Applied Social Psychology, 31*(1), 31-47.

Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1988). SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality. *Journal of Retailing, 64*(1), 12-40.

Peterson, R. E. (1977). The components of information. *Interfaces, 7*(4), 87-91.

Petter, S., Straub, D., & Rai, A. (2007). Specifying formative constructs in information systems research. *MIS Quarterly, 31*(4), 623-656.

Pinder, C. C. (1998). *Work motivation in organizational behavior*. New York: Prentice-Hall.

Pitt, L., Watson, R. T., & Kavan, C. B. (1995). Service quality: A measure of information systems effectiveness. *MIS Quarterly, 19*(2), 173-187.

Podsakoff, P. M., MacKenzie, S. B., Jeong-Yeon Lee, & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*(5), 879.

Podsakoff, P. M., & Organ, D. W. (1986). Self-reports in organizational research: Problems and prospects. *Journal of Management, 12*(4), 531.

Price, R., Neiger, D., & Shanks, G. (2008). Developing a measurement instrument for subjective aspects of information quality. *Communications of the Association for Information Systems, 2008*(22), 49-74.

Rai, A., Lang, S. S., & Welker, R. B. (2002). Assessing the validity of IS success models: An empirical test and theoretical analysis. *Information Systems Research, 13*(1), 50-69.

Ratchford, B. T. (1990). Marketing applications of the economics of product variety. *Marketing Science, 9*(3), 207.

Regan, E., & O'Conner, B. N. (1994). *End-user information systems: Perspective for managers and information systems professionals*. New York: Macmillan.

Rindfleisch, A., Malter, A. J., Ganesan, S., & Moorman, C. (2008). Cross-sectional versus longitudinal survey research: Concepts, findings, and guidelines. *Journal of Marketing Research (JMR), 45*(3), 261-279.

Ringle, C. M., Wende, S., & Will, A. (2005). *SmartPLS*. Hamburg, Germany:

Rogers, E. M. (1983). *Diffusion of innovation* (3rd ed.). New York: The Free Press.

Rosenberg, R. S. (1997). *The social impact of computers*. London: Academic Press.

Saga, V. L., & Zmud, R. W. (1994). The nature and determinants of IT acceptance, routinization, and infusion. In L. Levine (Ed.), *Diffusion, transfer, and implementation of information technology* (pp. 67-86). Amsterdam: Elsevier Science.

Schwarz, A., & Chin, W. (2007). Looking forward: Toward an understanding of the nature and definition of IT acceptance. *Journal of the Association for Information Systems, 8*(4), 232-243.

Seddon, P. B., Staples, S., & Patnayakuni, R. (1999). Dimensions of information systems success. *Communications of the Association for Information Systems, 2*

Seddon, P. B. (1997). A respecification and extension of the DeLone and McLean model of IS success. *Information Systems Research, 8*(3), 240.

Segars, A. H., & Grover, V. (1993). Re-examining perceived ease of use and usefulness: A confirmatory factor analysis. *MIS Quarterly, 17*(4), 517-525.

Sethi, V., & King, R. C. (1999). Nonlinear and noncompensatory models in user information satisfaction measurement. *Information Systems Research, 10*(1), 87-96.

Shannon, C. E., & Weaver, W. (1949). *The mathematical theory of communication*. Urbana, IL: University of Illinois Press.

Sheeran, P., Trafimow, D., & Armitage, C. J. (2003). Predicting behavior from perceived behavioral control: Tests of the accuracy assumption of the theory of planned behavior. *British Journal of Social Psychology, 42*(3), 393-410.

Silva, L. (2007). Post-positivist review of technology acceptance model. *Journal of the Association for Information Systems, 8*(4), 256-266.

Somers, T. M., Nelson, K., & Karimi, J. (2003). RESEARCH NOTE confirmatory factor analysis of the end-user computing satisfaction instrument: Replication within an ERP domain. *Decision Sciences, 34*(3), 595-621.

Spreng, R. A., & Page Jr., T. J. (2003). A test of alternative measures of disconfirmation. *Decision Sciences, 34*(1), 31-62.

Straub Jr., D. W., & Burton-Jones, A. (2007). Veni, vidi, vici: Breaking the TAM logjam. *Journal of the Association for Information Systems, 8*(4), 224-229.

Straub, D., Boudreau, M., & Gefen, D. (2004). Validation guidelines for is positivist research. *Communications of AIS, 2004*(13), 380-427.

Strong, D. M., Lee, Y. W., & Wang, R. Y. (1997). Data quality in context. *Communications of the ACM, 40*(5), 103-110.

Swanson, E. B. (1985). A note on information attributes. *Journal of Management Information Systems, 2*(3), 87-91.

Taylor, S., & Todd, P. (1995). Assessing IT usage: The role of prior experience. *MIS Quarterly, 19*(4), 561-570.

Thompson, R. L., & Higgins, C. A. (1991). Personal computing: Toward a conceptual model of utilization. *MIS Quarterly, 15*(1), 125-143.

Tse, D. K., & Wilton, P. C. (1988). Models of consumer satisfaction formation: An extensive. *Journal of Marketing Research (JMR), 25*(2), 204-212.

Vallerand, R. J. (1997). Toward a hierarchical model of intrinsic and extrinsic motivation. In M. Zanna (Ed.), *Advances in experimental social psychology* (pp. 271-360). New York: Academic Press.

Venkatesh, V., Brown, S. A., Maruping, L. M., & Bala, H. (2008). Predicting different conceptualizations of system use: The competing roles of behavioral intention, facilitating conditions, and behavioral expectation. *MIS Quarterly, 32*(3), 483-502.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science, 46*(2), 186.

Venkatesh, V., Davis, F. D., & Morris, M. G. (2007). Dead or alive? the development, trajectory and future of technology adoption research. *Journal of the Association for Information Systems, 8*(4), 268-286.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425-478.

Verplanken, B., Aarts, H., Van Knippenberg, A., & Van Knippenberg, C. (1994). Attitude versus general habit: Antecedents of travel mode choice. *Journal of Applied Social Psychology, 24*(4), 285-300.

Wand, Y., & Wang, R. Y. (1996). ANCHORING DATA QUALITY DIMENSIONS in ONTOLOGICAL FOUNDATIONS. *Communications of the ACM, 39*(11), 86-95.

Wang, R. Y., Storey, V. C., & Firth, C. P. (1995). A framework for analysis of data quality research. *IEEE Transactions on Knowledge and Data Engineering, 7*(4), 623-640.

Wang, R. W., & Strong, D. M. (1996). Beyond accuracy: What data quality means to data consumers. *Journal of Management Information Systems, 12*(4), 5-33.

Ward, J., Daniel, E., & Peppard, J. (2008). Building better business cases for it investments. *MIS Quarterly Executive, 7*(1), 1-15.

Warshaw, P. R., & Davis, F. D. (1984). Self-understanding and the accuracy of behavioral expectations. *Personality and Social Psychology Bulletin, 10*(1), 111-118.

Warshaw, P. R., & Davis, F. D. (1985). The accuracy of behavioral intention versus behavioral expectation for predicting behavioral goals. *Journal of Psychology, 119*(6), 599.

Watson, R. T., Pitt, L. F., & Kavan, C. B. (1998). Measuring information systems service quality: Lessons from two longitudinal case studies. *MIS Quarterly, 22*(1), 61-79.

Wetzels, M., Odekerken-Schröder, G., & van Oppen, C. (2009). Using pls path modeling for assessing hierarchical construct models: Guidelines and empirical illustration. *MIS Quarterly, 33*(1), 177-195.

Wixom, B. H., & Todd, P. A. (2005). A theoretical integration of user satisfaction and technology acceptance. *Information Systems Research, 16*(1), 85-102.

Zmud, R. W. (1978). An empirical investigation of the dimensionality of the concept of information. *Decision Sciences, 9*(2), 187-195.

Zviran, M., & Erlich, Z. (2003). Measuring is user satisfaction: Review and implications. *Communications of the Association for Information Systems, 2003*(12), 81-103.

BIOGRAPHICAL INFORMATION

Ralph Keng-Jung Yeh has many years of experience in information-related areas at Asia and the US with NASDAQ- and NYSE-listed companies. He received his PhD in Business Administration with a major in Information Systems and a minor in Management at The University of Texas at Arlington, and his Bachelor and Master of Business Administration from National Taiwan University. He plans to seek an academic career and his research interests pertain to the general phenomenon of technology utilization which contains, but is not limited to, technology use, technology management, IS success, and knowledge management.