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APPLYING MARKUS AND ROBEY'S CAUSAL STRUCTURE TO EXAMINE USER TECHNOLOGY ACCEPTANCE RESEARCH: A NEW APPROACH

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ABSTRACT

In this paper, we examine prior research on user technology acceptance from the perspective of theoretical structures based on Markus and Robey's causal structure. Prior studies usually take a technology imperative perspective, use variance theories, and emphasize the micro level of analysis. We argue that this combination is limited. This may lead to some inconsistencies and limited explanatory powers in the existing studies. We propose an alternative "emergent perspective – process theories – mixed level of analysis" approach to study technology acceptance phenomena. To demonstrate how the new approach can be used to guide research, a new research model is proposed and several propositions are derived and discussed. This study draws on several prior theories and models but reassembles them in a novel way. The paper concludes with implications for both research and practice.

INTRODUCTION

Organizations that spend millions of dollars on information technologies (IT) are primarily concerned with how their investment will influence organizational and individual performance (Torkzadeh and Doll 1999). However, the expected productivity gains and organizational benefits delivered by IT cannot be realized unless IT is actually accepted and used (Hackbarth, Grover and Yi 2003). User technology acceptance thus has been a focal research topic for decades in the Information Systems (IS) discipline and is considered "one of the most mature research areas in the contemporary IS literature" (Venkatesh, Morris, Davis and Davis 2003). A significant body of research has studied it from various perspectives.

Technology acceptance model (TAM) is a representative model in this stream of research. It has experienced improvements and refinement over the last fifteen years, and is considered the most well known model (Taylor and Todd 1995a). Yet the existing

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research on TAM presents inconsistencies and offers relatively low explanatory powers. Researchers have started to question the generalizability of TAM (Straub, Keil and Brenner 1997; Taylor and Todd 1995b; Venkatesh and Morris 2000). Some moderating factors such as age, gender, experience (Venkatesh and Morris 2000), characteristics of technology (Van der Heijden 2004), among other factors (Sun and Zhang 2006b) have been identified to account for the inconsistent relationships.

Along with attempts to identify the reasons behind inconsistent relationships and other limitations of TAM and its variations, we suspect that there are some fundamental aspects that deserve careful exploration and examination, one of which is the underlying theoretical structure (Markus and Robey 1988). On one hand, the structure of existing TAM models has rarely been reexamined to date. Our review of prior literature shows that such theoretical structures applied in prior research may be limited. On the other hand, the structures of theories play important roles in research methodologies. The awareness of different options, discussions of their advantages and disadvantages, and explicit characterization of a theoretical structure's dimensions and categories can promote the development of "better theories" (Markus and Robey 1988). When the theoretical structure is addressed explicitly, subsequent decisions about research strategy and techniques will be better informed (Markus and Robey 1988). Given the importance of theoretical structure in generating research questions, forming research frameworks, and guiding hypotheses and findings, it is necessary to systemically examine the theoretical structures underpinning prior research on user technology acceptance.

In this research, we use the meta-theoretical framework put forward by Markus and Robey (1988) to challenge the theoretical structures of existing TAM studies and propose different approaches. In pursuing a "good theory," Markus and Robey examined the general structure of theories and proposed three dimensions of a causal structure: causal agency, logical structure, and level of analysis. The concept of causal structure is consistent with other well-known theoretical framework (e.g. Orlikowski 1992) and has been applied to conceptualize information systems research in organizational contexts. Such a causal structure can help researchers to be more explicit about their position on causal agency, the logical structure of the theory, and its units of analysis (Johnston and Gregor 2000). In the area of user technology acceptance, Markus and Robey's causal structure framework can be a good tool to study the limitations of the current studies and point out future directions of user technology acceptance.

CONTRIBUTIONS

We highlight two contributions of this research. First, methodologically, this paper applies Markus and Robey's causal structure to review user technology acceptance research systematically. This research provides a new approach to study user technology acceptance, which proves to be helpful in understanding and analyzing user technology acceptance research. Second, to demonstrate the usefulness of the new approach, we develop a research model and corresponding propositions, which draw on several prior theories and models but reassemble them in a novel way. The research model and propositions broaden our view of user technology acceptance and can be used for future research in this area.

Therefore, the objective of this paper is to use Markus and Robey's framework to examine and explain inconsistencies in prior research on TAM, and to identify alternative approaches that may help us better understand user technology acceptance issues. To further demonstrate the usefulness of the new approach, a new research model is proposed, along with several propositions about the relationships among the important technology acceptance factors.

For practitioners of IS design and implication, this research offers insights into how organizational and technological factors play important roles in influencing employees' acceptance of the system in use and therefore provides implications for organizational training and system development. This research also suggests user technology acceptance is a process that should be

monitored and controlled. Experience and feedback also influence employees' acceptance of the system.

The remainder of the paper is organized as follows. After briefly introducing the research method, we start with the literature review focused on the inconsistencies existing in prior research on user technology acceptance. Then Markus and Robey's framework (1988) will be reviewed and applied to examine selected literature on TAM. Based on the review and analysis, a new research approach is proposed and several propositions are derived from this new approach to illustrate the benefit and explanatory value of it. We conclude with the study's implications for both researchers and practitioners.

THE REVIEW AND ANALYSIS OF PRIOR RESEARCH

Inconsistencies in Prior TAM Research

A variety of models have been developed to explain technology acceptance. Among them, TAM is the most well known (Taylor and Todd 1995a). TAM is an adaptation of Theory of Reasoned Action (Ajzen and Fishbein 1980; Fishbein and Ajzen 1975) specifically tailored for modeling user acceptance of information systems (Davis, Bagozzi and Warshaw 1989). TAM argues that (1) two particular beliefs, perceived usefulness (PU) and perceived ease of use (PEOU) are antecedents of attitude; (2) PU and attitude jointly determine a user's behavioral intention (BI); (3) PEOU has an effect on PU; and (4) external variables influence user BI only indirectly by influencing PU and PEOU or their relative weights.

The research on TAM has been proliferating for many years, and this has made a significant contribution to our understanding of user technology acceptance. A series of studies have been done to test (e.g. Adams, Nelson and Todd 1992; e.g. Davis 1989; Davis 1993; Davis, Bagozzi and Warshaw 1989), extend (e.g. Igbaria, Zinatelli, Cragg and Cavaye 1997; Venkatesh 2000; e.g. Venkatesh and Davis 1996; Venkatesh and Davis 2000), or compare TAM with other models (e.g. Davis, Bagozzi and Warshaw 1989; Mathieson 1991; Taylor and Todd 1995b; Venkatesh and Davis 2000). Overall, TAM is seen as a good parsimonious model to predict and measure user technology acceptance. Typically, TAM can account for 40% of variance in user technology acceptance (Venkatesh, Morris, Davis and Davis 2003).

However, the findings of existing TAM research are far from conclusive. The relationships within TAM have shown some inconsistencies among many TAM studies. For instance, PEOU generally has significant effects on BI (e.g. Adams, Nelson and Todd 1992; Igbaria, Zinatelli, Cragg and Cavaye 1997) and PU (e.g. Davis 1989; Davis, Bagozzi and Warshaw 1989; Mathieson 1991; Szajna 1996 etc; Taylor and Todd 1995a; Taylor and Todd 1995b; Venkatesh and Davis 2000). In some other cases, however, the effects are not significant (e.g. Chau and Hu 2002a; Subramanian 1994; Szajna 1996). Similar inconsistencies can also be found in the relationships between subjective norm (SN), defined as "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), and BI.

The above controversial results suggest that we need further explanations. Based on a comprehensive meta-analysis, we identified a set of possible moderating factors, shown in Table 1, such as gender, user's profession, experience, organization size, type of technology, and level of voluntariness, and proposed a contingency model of user technology acceptance.

Sun and Zhang (2006b) discussed various moderating factors systematically. In the present research, we approach the inconsistencies discussed above from a different perspective. Instead of identifying moderating factors, we take a theoretical structure perspective, which may provide a different angle to analyze the phenomena of user technology acceptance. Next, we will introduce the framework used in this research, based on which existing literature on user technology acceptance will be re-examined.

Markus and Robey's "Causal Structure"

There are three theoretical dimensions in the causal structure theory: causal agency, logical structure, and level of analysis.

Causal agency. Causal agency refers to "beliefs about the nature of causality: whether external forces cause changes, whether people act purposefully to accomplish intended objectives, or whether changes emerge unpredictably from the interaction of people and events" (Markus and Robey 1988 p. 583). There are three types of causal agency: technological imperative, organizational imperative, and emergent perspective. The perspective of technological imperative views technology as an exogenous force that determines the behavior of individuals and organizations (Markus and Robey 1988 p. 585). While providing insight into the often determining aspects of technology, technological imperative largely ignores the action of humans in developing, appropriating, and changing technology (Orlikowski 1992 p. 400).

In contrast, the perspective of organizational imperative argues that human actors design information systems to satisfy organizational needs for information. It is also called managerial choice or strategic choice, emphasizes that individuals *choose* how and when to apply IT to accomplish work in the organization (Orlikowski 1992; Pinsonneault and Kraemer 1993). However, organizational imperative has been criticized as relying too heavily on the capability of human agents (e.g. Orlikowski 1992).

The emergent perspective, however, holds that the uses and consequences of information technology emerge unpredictably from complex social interactions (Markus and Robey 1988 p. 583). The emergent perspective views the introduction of IT into an organizational setting as a catalyst, initiating a series of reciprocal causes and effects from which the use of the technology and the organizational outcomes arise (Jasperson, et al. 2002; Orlikowski 1992; Pinsonneault and Kraemer 1993).

Table 1: Examples of the Moderating Factors in TAM

Moderating Factors	Representative Works	Findings
Gender	(Gefen and Straub 1997; Venkatesh and Morris 2000)	Generally speaking, men are more driven by PU, while women are more motivated by PEOU and SN.
User's Profession	(Chau and Hu 2002a; Chau and Hu 2002b)	The relationships in the integrated TAM, such as PEOU-PU, PEOU-Attitude, and SN-BI, may differ between individual professionals and other user populations.
Experience	(Igbaria, Zinatelli, Cragg and Cavaye 1997; Taylor and Todd 1995a; Venkatesh and Davis 2000)	Experience may influence relationships between (1) BI and Usage, (2) PU and BI, (3) perceived behavioral control and BI, (4) PEOU and Attitude, (5) SN and PU, (6) external computer support and PEOU, (7) objective usability and PEOU, and (8) perceived enjoyment and PEOU.
Firm's Size	(Igbaria, Zinatelli, Cragg and Cavaye 1997)	Significant relationships within TAM for large firms may be non-significant for small ones, or vice versa.
Type of Technology	(Adams, Nelson and Todd 1992; Chau and Hu 2002a; Chau and Hu 2002b; Davis, Bagozzi and Warshaw 1989; Venkatesh and Davis 1996)	Two dimensions: (1) personal (e.g. word processing) vs. multi-person (e.g. email) technologies. Subjective norms may have less effect in personal technological contexts (2) Simple vs. complex technologies. The more complex a technology, the less relevant experience and subsequently a weaker link between perceived behavior control and BI.
Level of Voluntariness	(Venkatesh and Davis 2000)	SN has a direct effect on intentions for mandatory, but not voluntary, usage contexts, and therefore voluntariness is considered as a moderating factor.
Note: PU: Perceived Usefulness; PEOU: Perceived Ease of Use; BI: Behavioral Intention SN: Subjective Norms; A: Attitude		

It has been typified by studies applying the structurational model of technology (e.g. Orlikowski 1992; Pinsonneault and Kraemer 1993). For instance, Majchrzak et al. (2000) found a changing interaction between technological and organizational structures with the passage of time. Similarly, Leonard-Barton (1988) saw the technology adaptation process as cycles of misalignments, followed by alignments, followed by more but smaller misalignments, gradually evolving to a state in which the technology, the delivery system, and the performance criteria are aligned (Majchrzak, et al. 2000).

Logical structure. The logical structure concerns the logical formulation of the theoretical argument. Two types of logical structure have been identified: variance theories and process theories. Variance theories, also called "factor model," test empirical associations between predictors and outcomes. The assumption of variance theories is that variation in predictor (or independent) variables accounts for variation in outcome (or dependent) variables (Newman and Robey 1992). Variance theories associate a level of outcome with a level of predictor, inferring the causal linkages between the two (Newman and Robey 1992). However, they do not explain how outcomes occur. Process theories (or process models) can instead be used to explain how and why certain outcomes are achieved by focusing on the dynamics of social changes.

The distinction in theoretical structure between variance and process theories is analogous to the distinction between cross-sectional and longitudinal research methodologies (Markus and Robey 1988). While variance theories are mainly concerned with predicting the outcome by using certain predictors, process theories focus more on the development of the outcome. Process theories are concerned with explaining how outcomes develop over time. In variance theories, the predictors are posited as a necessary and sufficient condition for the outcome. In process theories, the precursor is assumed insufficient to "cause" the outcome, but is held to be merely necessary for it to occur (Newman and Robey 1992).

Levels of analysis. Three levels of analysis, macro, micro and mixed, have been identified by Markus and Robey (1988). Proponents of macro-level analysis explain social phenomena without applying such concepts as individual perceptions, attitudes, intention, and so on. In contrast, the basic logic of the micro-level of analysis is that social collectives consist of individuals, and macro concepts like organizational structure are permissible only when it is possible to ground them in the individual behaviors and the micro-level events and processes that comprise them (Pfeffer 1982). The mixed level of analysis, however, embraces both macro and micro concepts. "While the mixed-level strategy preserves macro-level concepts, it grounds these concepts in individual purposes and behavior and so remains 'methodologically individualist'" (Coleman 1986; Markus and Robey 1988).

A Theoretical Structure Analysis of Prior Research

In this part, we will analyze existing literature on user technology acceptance using Markus and Robey's causal structure framework discussed above. We apply their three theoretical dimensions to re-examine prior technology acceptance studies. Table 2 summarizes the major findings of this analysis.

Causal agency. Table 2 indicates that prior studies mainly utilized a technological imperative perspective. The major efforts are to identify the antecedents of users' behavioral intention, attitude, and perceptions (e.g. perceived usefulness, and perceived ease of use). For example, in the original TAM, the technical factors are described as "external factors" that can influence users' perceptions and subsequently influence their attitude, behavioral intention, and actual usage (Davis 1989; Davis, Bagozzi and Warshaw 1989). In TAM, the relation between technology and organizations/individuals (human agents) is one-way, from technology to organizations/individuals (human agents). We argue that the reciprocal relationships between technological spirit and organizational structures or their human agents (individuals) should be considered since the technological imperative lacks the ability to address the phenomena of interest in deeper societal structures (Jasperson, et al. 2002). Therefore the emergent perspective may be more

appropriate for technology acceptance research.

Logical structure. While most of prior research used variance theories, there were some researchers who used process theories. For example, Venkatesh and Davis (2000) conducted longitudinal research and found the changing effects of the antecedents of perceived usefulness. Similarly, Bhattacherjee (2004) integrated TAM with expectation-disconfirmation theory (EDT) to describe *how* IT users' beliefs and attitudes toward information technology change over time. One of the major advantages of the process theory is that it retains the empirical fidelity of the emergent perspective when preserving predictability and generalizability (Markus and Robey 1988). Prior research has demonstrated the changes in user acceptance behavior (Bhattacherjee and Premkumar 2004). The limited usefulness of variance theories for explaining and controlling IS-related change within single organizations is now recognized theoretically and empirically in the IS literature (Markus and Robey 1988; Orlikowski and Robey 1991). Considering the complexity and the dynamics of human behavior and the practical needs for more explanations of user technology acceptance, process theories therefore may be more appropriate for the research on user technology acceptance. In addition, while recognizing and accepting the complexity of causal relationships, process theories do not abandon the goals of generalizability and prediction. Generalizability and prediction are two goals of IS research.

Level of analysis. Prior research focuses mainly on individual perceptions at the micro-level of analysis (Table 2). Sometimes this research took contextual factors into account (e.g. Chau and Hu 2002a; Chau and Hu 2002b; e.g. Taylor and Todd 1995a; Venkatesh and Davis 2000). The mixed level of analysis, as Coleman said, is "not to remain at the macro-social level but to move down to the level of individual actions and back up again" (Coleman 1986 p.1322). The mixed level of analysis reflects the increasing awareness of the importance of the contextual factors. User technology acceptance cannot be isolated from social and organizational contexts. So the mixed-level of analysis should be appropriate to bridge the gaps between organizational and individual concepts.

We summarize the old and new approaches in Figure 1. The solid line represents the new perspective suggested in this study and the dashed lines represent the perspectives generally used in prior research. Based on above discussions, we propose an "emergent perspective – process theories – mixed-level of analysis" approach to study user technology acceptance in organizations and other contexts.

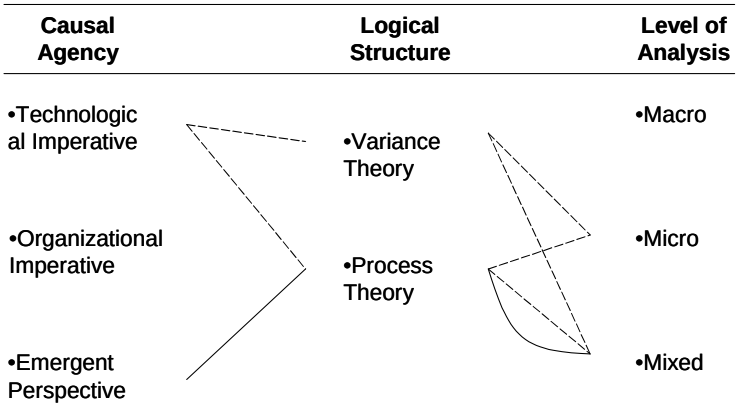
DEMONSTRATING THE NEW APPROACH: A NEW RESEARCH MODEL AND PROPOSITIONS

Up to this point, we have discussed the new approach to user technology acceptance at a high and abstract level. This section demonstrates how this approach can be applied to guide research at a concrete level. Specifically, we develop a research model of user technology acceptance guided by the new approach. Along the way, we provide actionable propositions for future research. We want to make sure that all relevant propositions in the new model are discussed in order to provide a holistic picture of the new model. There are some overlaps between the propositions we discuss here and propositions developed under the previous research perspective.

Based on the new research perspective, we outline a new model in Figure 2. Three ovals represent the three basic units in the approach, technology, organization, and individuals. The emergent perspective is reflected by the three double arrows in the middle, which means the interactions among technologies, organizations, and individuals.

Table 2: The theoretical structure analysis of existing research

Article ID	Causal Agency	Logical structure	Level of analysis	Article ID	Causal Agency	Logical Structure	Level of analysis
(Davis 1989)	Tech. Imperative	Process theory	Micro	(Dishaw and Strong 1999)	Emergent perspective	Variance Theory	Micro
(Davis, Bagozzi and Warshaw 1989)	Tech imperative	Process theory	Micro	(Hu, Chau, Sheng and Tam 1999)	Tech imperative	Variance theory	Mixed
(Mathieson 1991)	Tech imperative	Process theory	Micro	(Karahanna and Straub 1999)	Tech imperative	Variance theory	Micro
(Adams, Nelson and Todd 1992)	Tech imperative	Variance theory	Micro	(Lucas and Spitler 1999)	Tech imperative	Variance theory	Micro
(Szajna 1994)	Tech imperative	Variance theory	Micro	(Teo, Lim and Lai 1999)	Tech imperative	Variance theory	Micro
(Keil, Beranek and Konsynski 1995)	Tech imperative	Process theory	Mixed	(Venkatesh 1999)	Tech imperative	Process theory	Micro
(Taylor and Todd 1995b)	Tech imperative	Variance theory	Micro	(Cheung 2000)	Tech imperative	Variance theory	Mixed
(Taylor and Todd 1995a)	Tech imperative	Process theory	Micro	(Venkatesh and Davis 2000)	Tech imperative	Process theory	Micro
(Chau 1996)	Tech imperative	Variance theory	Micro	(Venkatesh and Morris 2000)	Tech imperative	Variance theory	Micro
(Davis and Venkatesh 1996)	Tech imperative	Process theory	Micro	(Morris and Turner 2001)	Tech imperative	Process theory	Micro
(Venkatesh and Davis 1996)	Tech imperative	Variance theory	Micro	(Chau and Hu 2002a)	Tech imperative	Variance theory	Mixed
(Szajna 1996)	Tech imperative	Process theory	Micro	(Chau and Hu 2002b)	Tech imperative	Variance theory	Mixed
(Gefen and Straub 1997)	Tech imperative	Process theory	Micro	(Chen, Gillenson and Sherrell 2002)	Tech imperative	Variance theory	Micro
(Igbaria and Tan 1997)	Tech imperative	Variance theory	Micro	(Hackbarth, Grover and Yi 2003)	Tech imperative	Process theory	Micro
(Igbaria, Zinatelli, Cragg and Cavaye 1997)	Tech imperative	Process theory	Micro	(Bhattacherjee and Premkumar 2004)	Tech imperative	Process theory	Micro
(Straub, Keil and Brenner 1997)	Tech imperative	Variance theory	Mixed	(Van der Heijden 2004)	Tech imperative	Variance theory	Micro
(Agarwal and Prasad 1998)	Tech imperative	Variance theory	Micro				



Note: Solid line represents the new perspective suggested in this study and the dashed lines represent the perspectives used in prior research

Figure 1: The mapping of old and new approaches

The experience/feedbacks arrows at the right side reflect the process theories. The inclusion of individual and organizations simultaneously implies a mixed-level of analysis. It is noteworthy that the proposed model is not limited just to the original constructs in TAM. The links between the technology acceptance model (TAM), and task-technology fit (TTF) and computer self-efficacy (CSE), two notable concepts closely related to user technology acceptance, can be easily located in the new model.

Task-Technology Fit refers to "the degree to which a technology assists an individual in performing his or her portfolio of tasks" (Goodhue and Thompson 1995). Computer self-efficacy (CSE) "reflects an individual's beliefs about his or her abilities to use computers" (Compeau and Higgins 1995a; Compeau and Higgins 1995b). The relationships among the three models will be explained in detail next when we develop propositions based on the new model.

TAM model has two independent variables, perceived usefulness and perceived ease of use, and one dependent variable, behavioral intention. Perceived usefulness is defined as "the degree to which a person believes that using a particular technology will enhance his performance" (Davis 1989 p.320). PEOU, on the other hand, is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis 1989 p.320). Behavioral intention (BI) is used in this research as the surrogate for user technology acceptance. BI has been confirmed to be a valid and robust indicator of user technology acceptance (Sun and Zhang 2006b).

Propositions from the emergent perspective

The emergent perspective focuses on the interactions among technologies, individuals, and organizations. From this perspective, the organizational and technological readiness, which refers to the implementation gaps and transitional support respectively in Chau's research (1996), influence user acceptance. Organizational contingency theories (Galbraith 1973; Van de Ven and Delbecq 1974; Van de Ven and Drazin 1985) can provide some implications. While contingency theorists argue that an organization's structure must "fit" its organizational context, technology must fit organizational goals similarly. The gaps between organizational goals and technological functions influence users' perceived usefulness and ease of use of information systems. This relationship has not yet been studied. We propose that:

P1-a: The gaps between organizational goals and system functions influence the perceived usefulness and perceived ease of use.

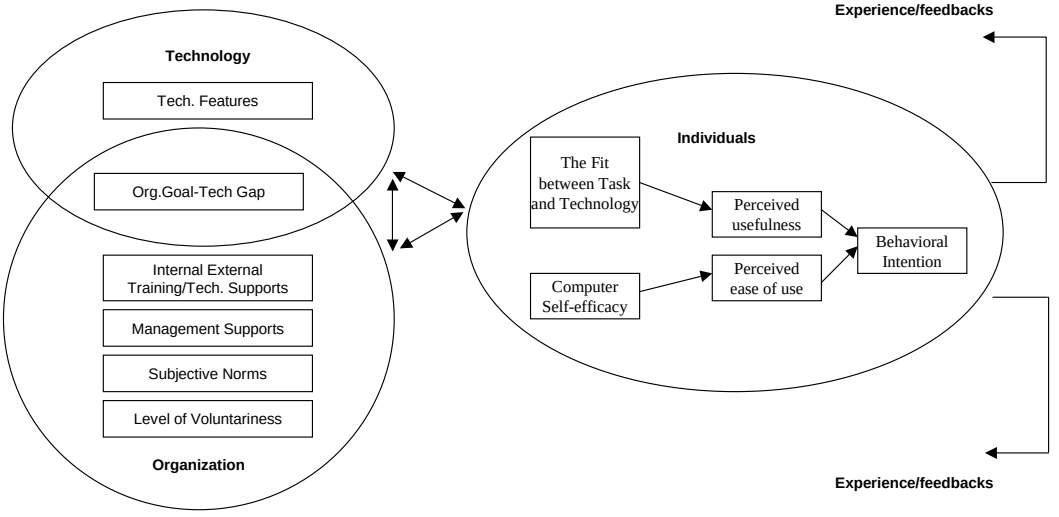


Figure 2: The proposed research model based on the new approach

More specifically, we can refer to the Task-Technology Fit (TTF) model[1] (Goodhue 1995; Goodhue and Thompson 1995; Zigurs and Buckland 1998) for the interaction between technology and tasks, a major aspect of organizational structures. While the gaps between organizational goals and system functions are at the organizational level, the fit between task and technology is "at the individual level" (Goodhue 1995 p. 1831) (Goodhue 2006). It addresses the individual task and the technology. According to the TTF model, the fit between task and technology influences user's performance.

While the fit is at an individual level, it does reflect some organizational aspects. For example, Goodhue and Thompson have demonstrated that the employees at different organizational hierarchies (which are closely related to the organizational structure) have different task requirements and subsequently different user evaluations of task-technology fit (Goodhue and Thompson 1995). Therefore, we argue that organizational structures can be reflected via tasks.

Dishaw and Strong have integrated TTF with TAM to demonstrate how the fit between task and technology influences user technology acceptance (Dishaw and Strong 1999). The fit between task and technology is a mediating factor that links the task, technology, and individual characteristics to utilization. Traditional TAM studies used the term "external factors" to include all the task, technology, and individual characteristics and assumed these characteristics influence two belief factors, perceived usefulness and perceived ease of use, which subsequently influence user attitude or behavioral intention. The fit between task and technology construct, however, mediates the impact of "external factors" on perceived usefulness and perceived ease of use (Goodhue 2006). Thus, we propose that:

> P1-b: The fit between task and technology influences perceived usefulness and perceived ease of use.

Internal trainings and support, which are also confirmed to have significant effects on perceived usefulness and perceived ease of use (Igbaria, Zinatelli, Cragg and Cavaye 1997). First, external and internal technical support are crucial to user technology acceptance (Raymond 1990). A high availability of technical support may ease users' concerns about the complexity and security of the technology and promote users' willingness to accept it. Researchers have found positive relationships between user acceptance and various technical support (Igbaria, Zinatelli, Cragg and Cavaye 1997; Mirani and King 1994). Second, prior research has reported that training, external and internal, promotes greater understanding, favorable attitude, more frequent use, and

more diverse use of applications (Raymond 1990). It has been empirically confirmed that training has significant impacts on user technology acceptance (Igbaria, Zinatelli, Cragg and Cavaye 1997).

Igbaria and colleagues (Igbaria, Zinatelli, Cragg and Cavaye 1997) examined the influence of external and internal training and support. Their study showed that internal training significantly influences perceived usefulness, and external training influences perceived ease of use, while external support have effects on both perceived usefulness and perceived ease of use. Their results did not support certain links as we propose in our model. For example, they did not find a significant effect of external training on perceived usefulness as hypothesized. Given the fact that their research is limited to small firms, these non-significant findings may become significant for large firms. In fact, Raymond (1990) argued that training is an important factor affecting personal computing acceptance in both large and small firms. Therefore, we generalize their findings and propose that:

P1-c: External and internal training are positively related to perceived usefulness and perceived ease of use.

P1-d: External and internal technological support are positively related to perceived usefulness and perceived ease of use.

Another direction is from individuals to technologies. There are many types of impacts that individuals have on technologies. The common one, and also the most obvious, is the impact of designers. As Orlikowski and Barley stated, technology is "simultaneously social and physical artifacts" (Orlikowski and Barley 2001). All technologies represent a particular set of choices made by specific designers (Bucciarelli 1994). On the other hand, the users may also have impacts on the systems, which can in turn affect user acceptance and satisfaction (Baroudi, Olson and Ives 1986). First, based on their own tasks requirements, users may exert their influences at the stages of system design and implementation through involvement and participation. Second, users' experience and lessons gained from actual use will influence the further improvement of technologies, which can enhance the users' future acceptance. Empirical studies also support the significant relationships between user involvement and user acceptance (Hartwick and Barki 1994). It is noteworthy that this stream of research is not new at all. It was studied extensively during the 1980s. We discuss it here to illustrate the reciprocal relationship between technology and user. We thus propose that:

P1-e: The level of user involvement/participation at the technology design and implementation stages is positively related to system quality.

P1-f: The level of user involvement/participation at the technology design and implementation stages is positively related to user acceptance in later stage.

A new form of individuals' impact on technology that deserves more attentions from IS research is that individual users can determine the way technology is used and thus shape the final nature of the technology and corresponding beliefs and intentions toward using the current and future technology (indicated by the arrow from individual to technology in Figure 2). This "user→technology" direction challenges the fundamental assumption of user technology acceptance research by proposing the active roles of users in human-computer interaction. Explicitly stated, users are not considered passive takers of technology by simply accepting and using a system in the predefined way by developers. Instead, they can purposely select, reproduce, and reshape the technology in use. To put this more formally, we can consider users' active actions on technology as *technology appropriation* that is "the continuous, progressive, and mutual adjustments, accommodations, and improvisations between the technology and the users" (Orlikowski 1996, p69). In the same vein, the Adaptive Structuration Theory (AST, DeSanctis and Poole 1994; Poole and DeSanctis 1990; Poole and Desanctis 1992) also argues that users can appropriate given technology, especially its structure and spirit.

Furthermore, Sun and Zhang developed a concept called "adaptive IT use" (AITU) to represent users' appropriation behaviors

towards technology at the individual level (Sun and Zhang 2006a). Defined as "users' appropriation behavior of modifying technology's feature set and / or the spirit of the feature set in an adaptive manner", According to their work, users can have six types of actions on technology: decreasing feature set, expanding feature set, substitutive moves, combining, repurposing, and reproducing. All these concepts are in essence aimed at understanding the active roles of users in the interaction with technology. We integrate these concepts and propose that:

P1-g: Users' appropriation of *technology determines the* nature of technology, which further determines user acceptance of current and future technology.

Propositions from process theories

Two foci are involved in process theories. One is the role of time, and the other the relationship between outcomes and the necessary conditions.

Experience is a major issue associated with the role of time. Actually, a positive feature of process theories is their faithful account of actual experiences (Newman and Robey 1992). Users may employ the knowledge gained from their prior experience to form their intentions (Fishbein and Ajzen 1975). Generally speaking, TAM is an effective model for both experienced and inexperienced users, accounting for a reasonable proportion of the variance in intention and behavior (Taylor and Todd 1995a). However, the relationships within TAM are different between experienced and inexperienced users. Or, to put it another way, users' beliefs and attitudes toward using an information technology may change based on their own experience with the IT (Bhattacherjee and Premkumar 2004). The literature review suggests that experience may moderate the relationships in TAM. For example, perceived ease of use has significant impacts on behavioral intention for inexperienced users, but not for experienced users (Venkatesh, Morris, Davis and Davis 2003). Similar moderating effects can also be observed for the SN-BI relationship. This moderating effect has been empirically confirmed. However, it is viewed as the result of process theories here. We thus restate it here:

P2-a: Prior similar experience moderates the effects of perceived usefulness and perceived ease of use on behavioral intention.

A similar concept refers to the feedback in Goodhue and Thompson's research (1995). Feedback is defined as the result of actions taken and the relationship between performance at each chronological phase in experience and subsequent result (Toki 2000). Once a technology is used, there will inevitably be various feedbacks to it, which may be considered for further improvement (Goodhue and Thompson 1995). The individuals may also learn from the experience better ways of utilizing technology and subsequently improve the fit between task and technology (Goodhue 1995; Goodhue 2006). Therefore, there are two channels through which feedback influences user technology acceptance. One is the effect of experience on individuals, and the other is the effect on the technology, both of which can influence the fit between task and technology (Goodhue 1995). As for the first one, we can refer to computer self-efficacy (CSE), which "reflects an individual's beliefs about his or her abilities to use computers" (Compeau and Higgins 1995a; Compeau and Higgins 1995b). Experience has been confirmed to have significant effects on CSE (Agarwal and Karahanna 2000; Compeau and Higgins 1995a; Compeau and Higgins 1995b; Compeau, Higgins and Huff 1999; Hill 1987; Johnson and Marakas 2000). As for the effect of prior experience on technology, we can go back to Propositions 1-e and 1-f, which propose that the level of user involvement at the system design or implementation stage is positively related to system quality and user acceptance, respectively. Therefore, based on the experience from actual usage, users can exert their influence directly on system improvement. We summarize the above discussions and come up with the following propositions, which has received little attention:

P2-b: Experience can influence technology acceptance through user computer self-efficacy.

P2-c: Feedback can enhance subsequent task-technology fit via people and technology respectively, and further can influence future technology acceptance.

The second focus concerning process theories is about the relationship between outcomes and the necessary conditions. According to process theories, outcomes may or may not happen, even if all the contingent conditions are met (Markus and Robey 1988; Newman and Robey 1992). In other words, the antecedents are necessary but not sufficient for the outcomes. Some random events are also important for the final outcomes. Subsequently, we cannot propose that "the more antecedents, the more outcomes," What we can say is "if there are no antecedents, the outcome will not occur." This idea will be reflected in all of the propositions in this study. We use propositions like "X has positive/negative effects on Y" or "X positively/negatively influences Y" rather than "the more X, the more Y," which is a typical pattern of variance theories.

Propositions from the mixed-level of analysis

The major focus of mixed-level of analysis is the interaction between organizations (macro) and individuals (micro). Individual perceptions have effects on organizational structures and in turn, the new reshaped organizational structures will influence individual perceptions (Majchrzak, et al. 2000). We discussed training and technical support in Section 4.1. In this part, we focus our attention on other organizational factors that have significant impacts on individuals.

Management support is an example of the effect of organizational hierarchy on individual perceptions. Prior studies have proved that management support is one of the critical factors affecting IS success (e.g. Igbaria, Guimaraes and Davis 1995; e.g. Kwon and Zmud 1987). Management support can create a more conducive environment and ensure sufficient allocation of resources (Igbaria, Zinatelli, Cragg and Cavaye 1997). Specifically, management support, which was considered to have positive impacts on perceived usefulness and perceived ease of use, was a type of transitional support (Chau 1996). This relationship has been explored and we restate it here:

P3-a: Management support have positive effects on perceived usefulness and ease of use.

Both the Theory of Reasoned Action (Fishbein and Ajzen 1975) and the Theory of Planned Behavior (Ajzen 1991), argue that subjective norms have significant effects on user behavior. In the specific area of user technology acceptance, subjective norms are less studied and have relatively unstable effects on user technology acceptance. The effects of subjective norms are not consistent across prior studies. On one hand, it appears to have no significant direct effects on behavioral intention (e.g. Chau and Hu 2002a; e.g. Davis, Bagozzi and Warshaw 1989; Dishaw and Strong 1999; Mathieson 1991; Venkatesh and Morris 2000). On the other hand, however, it does have a significant direct effect on behavioral intention in some cases (e.g. Lucas and Spitler 1999; e.g. Taylor and Todd 1995b). Experience is considered as a possible moderating factor that accounts for the inconsistency (Venkatesh and Davis 2000; Venkatesh, Morris, Davis and Davis 2003). Specifically, SN has a more significant effect on behavioral intention for inexperienced users than for experienced users. Although this moderating effect has been empirically confirmed, it is the first time that subjective norms and user technology acceptance are categorized in different groups in the research model. Subjective norms are considered as an organizational factor and user technology acceptance is at the individual level. We propose that:

P3-b: SN has a significant effect on behavioral intention for inexperienced users, but not so for experienced users.

Another factor is the level of voluntariness. The level of voluntariness is defined as "the extent to which potential adopters perceive the adoption decision to be non-mandatory" (Moore and Izak 1991; Venkatesh and Davis 2000). One of the major sources of voluntariness is from the organization. Even when users perceive system use to be organizationally mandated, usage intentions vary because some users are unwilling to comply with such mandates

(Venkatesh and Davis 2000). Furthermore, in Venkatesh and Davis's research (2000), SN has a direct effect on intentions for mandatory, but not voluntary, usage contexts, and therefore the level of voluntariness is considered to be a moderating factor (e.g. Venkatesh and Davis 2000). Thus we propose that:

P3-c: The level of voluntariness moderates the effect of SN on behavioral intention

Table 3 summarizes the above propositions. We can see again that the new approach yields several new propositions and synthesizes existing propositions.

Table 3: A summary of propositions

Proposition	New / existing	Note
P1-a: The gaps between organizational goals and system functions influence the perceived usefulness and perceived ease of use	New	
P1-b: The fit between task and technology influences perceived usefulness and perceived ease of use.	New	
P1-c: External and internal training are positively related to perceived usefulness and perceived ease of use.	Existing	
P1-d: External and internal technological support are positively related to perceived usefulness and perceived ease of use.	Existing	
P1-e: The level of user involvement/participation at the technology design and implementation stages is positively related to system quality.	Existing	
P1-f: The level of user involvement/participation at the technology design and implementation stages is positively related to user acceptance in later stage.	Existing	
P1-g: Users' appropriation of technology determines the nature of technology, which further determines user acceptance of current and future technology.	New	
P2-a: Prior similar experience moderates the effects of perceived usefulness and perceived ease of use on behavioral intention.	Existing	It is viewed as the result of process theories in this paper.
P2-b: Experience can influence technology acceptance through user computer self-efficacy.	New	
P2-c: Feedback can enhance subsequent fit between task and technology via people and technology respectively, and can further influence future technology acceptance.	New	
P3-a: Management support have positive effects on perceived usefulness and ease of use	Existing	
P3-b: SN has a significant effect on behavioral intention for inexperienced users, but not so for experienced users.	Existing	Subjective norms and user technology acceptance are categorized in different groups in the research model. Subjective norms are considered as an organizational factor and technology acceptance is at the individual level.
P3-c: The level of voluntariness moderates the effect of SN on behavioral intention.	Existing	

DISCUSSIONS

Based on Markus and Robey's causal structure framework, the theoretical structure of previous user technology acceptance research can be described as "technological imperative – variance theories- micro or mixed level of analysis" or "technological imperative - process theories – micro or mixed level of analysis". Given the nature of user technology acceptance, this study suggests an alternative approach of "emergent perspective - process theory - mixed-level of analysis" should be a more appropriate approach to analyze user technology acceptance, which can explain the inconsistencies existing in the prior research. Furthermore, from this perspective we can not only derive existing propositions in previous research, but also find new relationships and develop new propositions. For instance, we can propose a new "individual user→technology" direction instead of the traditional "technology→user acceptance" direction and new propositions based on this relationship can be developed accordingly.

The main contribution of this research is the new "emergent perspective – process theories – mixed level of analysis" approach. Using this approach, we can study user technology acceptance phenomena from a new perspective. We would like to highlight the following new findings of this research:

1. From the "emergent perspective", we propose a new proposition regarding the relationship between the gaps between organizational goals and system functions and the perceived usefulness and perceived ease of use. We suggest considering the individual→technology direction, apart from the traditional technology→individual reaction direction. Specifically, we suggest studying how individuals "appropriate" technology and influence technology design and utilization. That is, users are gradually considered not passive takers of technology. Instead, they can purposely select, reproduce, and reshape the technology in use and provide suggestions for technology design.
2. We suggest studying user technology acceptance as a process. We highlight the impacts of experience and feedback in user technology acceptance and system design. While users get more experienced with technology in general, they are more likely to have higher computer self-efficacy and pay more attention to the usefulness, rather than the ease of use, of the technology. Positive feedback, on the other hand, can enhance subsequent task-technology fit via people and technology respectively, and can further influence future technology acceptance.
3. Also, user technology acceptance should be studied at the mixed-level of analysis. We suggest paying more attention to the interaction between organizations (macro) and individual users (micro). How to influence individual users' acceptance via policy, leaders, IT departments at the organizational level should receive more attention.

Again, the most important contribution of this research is a new methodological approach, which yields us a new perspective to study user technology acceptance from "the emergent perspective", as a process, and at the mixed level of analysis. This research demonstrates how this approach is useful in studying user technology acceptance and synthesizing existing research on user technology acceptance systematically.

This research has theoretical and research implications. First, we break the conventional theoretical structure that dominates the research stream and provide a different approach to analyze user technology acceptance. This study draws on many prior studies on computer self-efficacy (CSE, Compeau and Higgins 1995a; CSE, Compeau and Higgins 1995b) and task-technology fit (TTF, Goodhue 1995; TTF, Goodhue and Thompson 1995; Zigurs and Buckland 1998), and user involvement (Barki and Hartwick 1989), but reassembles them in a novel way. Second, our work is an attempt to link the findings at the individual level and at the organizational level with a theoretically guided methodological framework. An integrated view of the use of IT within organizational, social, and global contexts is the current trend. Therefore, considering user technology acceptance in broader organizational contexts

is important for further research and practice. The mixed level of analysis may help us in achieving this goal. As a result, many existing organizational theories can be applied to study individual technology acceptance. In fact, there are many related organizational theories or concepts concerning the links between organizations and individuals. For example, organization culture (Martin 1992; Robey and Azevedo 1994; Schein 1996) is closely related to subjective norm, which has received discussions in prior technology acceptance research. These conceptual similarities prompt possible research topics for further study.

This research also has practical implications. First, more technological and organizational support is needed to promote user technology acceptance. We present how organizational and technological factors can influence technology acceptance at the individual level. These factors should be emphasized when promoting employees' acceptance of certain technologies such as Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) systems in organizational environments. Second, we have suggested that user behavior can in turn influence technological and organizational structures. This influence has been traditionally ignored. Third, user technology acceptance is a *process*. Along with the accumulation of experience, user perceptions and acceptance of the same technology may change. So taking a more dynamic perspective and being more open minded will benefit the understanding of how user technology acceptance changes over time. It echoes recent calls for studying post-adoptive system use (Kim and Malhotra 2005).

CONCLUSION

User technology acceptance is an important topic and receives a lot of attention from the IS researchers. This research addresses the methodological concerns underlying the previous IS research. We use the meta-theoretical framework put forward by Markus and Robey (1988) to challenge the theoretical structures of existing TAM studies and propose a different approach. By doing so, we are able to synthesize several theories and models that seem scattered and independent from each other. This research demonstrates the usefulness of Markus and Robey's causal structure in guiding research on user technology acceptance.

[1] Task-Technology Fit (TTF) model is developed around a core construct called task-technology fit. To avoid confusions between the model and the construct in this paper, we will use "fit between task and technology" for the "task-technology-fit" construct in the original TTFmodel.

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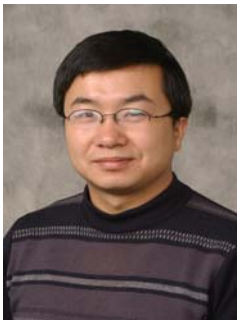

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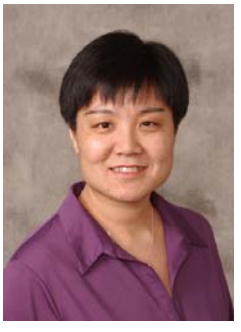

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