A Methodological Analysis of User Technology Acceptance

Heshan Sun
School of Information Studies
Syracuse University
hesun@syr.edu

Ping Zhang
School of Information Studies
Syracuse University
pzhang@syr.edu

Abstract

The majority of research on user technology acceptance, e.g. technology acceptance model, focuses on individual users' beliefs, attitudes, and behavioral intentions toward technology use. In this paper, we attempt to examine prior research on user technology acceptance from a methodological angle by borrowing Markus and Robey's research framework (1988). We find that prior studies usually take technology imperative perspective, use variance theories, and emphasize the micro level of analysis. Therefore, we propose an "emergent perspective – process theories – mixed level of analysis" approach to analyze user technology acceptance. From this perspective, a new model is proposed and several propositions are derived and discussed. This study draws on several prior theories and models, such as the technology acceptance model, computer self-efficacy and the task-technology fit model, but reassembles them in a novel way. The paper concludes with the research and practical implications.

1. Introduction

A variety of models have been developed to explain IT acceptance. Among them, Technology Acceptance Model (TAM) is the most well known (Taylor and Todd, 1995b). Overall, TAM is seen as a good parsimonious model to predict and measure user technology acceptance. The research on TAM has been proliferating for many years, which has made significant contribution to our understanding of user technology acceptance. Typically, TAM can account for 40% of variance in user technology acceptance. Compared with other models, e.g. Theory of Planned Behavior (TPB), TAM performs just slightly better (Taylor and Todd, 1995a). In addition, the relationships within TAM have shown some inconsistency among many TAM studies (e.g. Sun, 2003).

One of the motivations of this study is to explore the existing inconsistencies in prior research on TAM. Several researchers start to question the generalizability of TAM (e.g. Straub, et al., 1997; Taylor and Todd, 1995b; Venkatesh, and Morris, 2000). Some moderating factors have been identified, which may account for the inconsistencies. However, these attempts mostly take the micro-level of analysis. The other two possible levels of analysis are macro, and mixed levels (Markus and Robey, 1988). Each of these three has its own advantages and disadvantages. The level of analysis is only one aspect of Markus and Robey's causal structure (1988). Apart from the level of analysis, causal agency and logical structure are also important. Examining the inconsistencies from all the three aspects may give us some new indications about user technology acceptance. Therefore, the objective of this paper is to explain the existing inconsistencies in prior research from a new methodological perspective. This leads to the study's research questions:

RQ 1: What are the methodological perspectives of the prior research on technology acceptance?
RQ 2: What is an alternative methodology that may explain the limitations and inconsistencies of the prior research?
RQ 3: How can this methodological perspective help us to understand user technology acceptance?

The contribution of this study is two-fold: (1) by examining existing studies and the inconsistencies from a methodological angle, we shed new light on the limitations and potential improvement of an important research area. (2) The new approach and the corresponding propositions can lead to future studies on user technology acceptance.

2. Method

The following IS journals were searched systematically in order to identify representative studies on technology acceptance: *Decision Science, Decision Support Systems, International Journal of Human-Computer Studies (International Journal of Man-Machine Studies), Information Systems Research, Information & Management, Journal of Management Information Systems, Management Science, MIS Quarterly, OMEGA International Journal of Management Science*. Finally, we selected 31 articles (Table 1) by the following criteria: (1) the articles are empirical research; (2) user technology acceptance receives substantive consideration; and (3) the results are complete and discussed in details.

3. A Review and Methodological Analysis of Prior Research

3.1. Marakus and Robey's "Causal Structure"

To broaden our view of user technology acceptance, we examine existing studies from a methodological perspective. Here we use Markus and Robey's (1988) "causal structure" as the major method to analyze prior studies.

There are three 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. In contrast, the perspective of organizational imperative argues that human actors design information systems to satisfy organizational needs for information. The emergent perspective, however, holds that the uses and consequences of information technology emerge unpredictably from complex social interactions (Markus and Robey, 1988).

Logical structure. It concerns the logical formulation of the theoretical argument. 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 mainly concern predicting the outcome by using certain predictors, process theories focus more on the development of the outcome.

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 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, p. 595)

3.2. A Methodological Analysis of Prior Research

Table 1: the methodological analysis of existing TAM researches

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	Agarwal & Prasad, 1998	Tech imperative	Variance theory	Micro
Davis et al., 1989	Tech imperative	Process theory	Micro	Dishaw & Strong, 1999	Emergent perspective	Variance Theory	Micro
Mathieson, 1991	Tech imperative	Process theory	Micro	Hu, et al., 1999	Tech imperative	Variance theory	Mixed
Adams et al., 1992	Tech imperative	Variance theory	Micro	Karahanna & Straub, 1999	Tech imperative	Variance theory	Micro
Szajna, 1994	Tech imperative	Variance theory	Micro	Lucas & Spitler, 1999	Tech imperative	Variance theory	Micro
Keil et al., 1995	Tech imperative	Process theory	Mixed	Teo et al., 1999	Tech imperative	Variance theory	Micro
Taylor & Todd, 1995a	Tech imperative	Variance theory	Micro	Venkatesh, 1999	Tech imperative	Process theory	Micro
Taylor & Todd, 1995b	Tech imperative	Process theory	Micro	Cheung et al., 2000	Tech impeartive	Variance theory	Mixed
Chau, 1996	Tech imperative	Variance theory	Micro	Venkatesh & Davis, 2000	Tech imperative	Process theory	Micro
Davis & Venkatesh, 1996	Tech imperative	Process theory	Micro	Venkatesh & Morris, 2000	Tech imperative	Variance theory	Micro
Venkatesh & Davis, 1996	Tech imperative	Variance theory	Micro	Morris & Turner, 2001	Tech imperative	Process theory	Micro
Szajna, 1996	Tech imperative	Process theory	Micro	Chau & Hu, 2002a	Tech imperative	Variance theory	Mixed
Gefen & Straub, 1997	Tech imperative	Process theory	Micro	Chau & Hu, 2002b	Tech imperative	Variance theory	Mixed
Igbaria & Tan, 1997	Tech imperative	Variance theory	Micro	Chen et al., 2002	Tech imperative	Variance theory	Micro
Igbaria et al., 1997	Emergent perspective	Process theory	Micro	Hackbarth et al., 2003	Tech imperative	Process theory	Micro
Straub et al., 1997	Tech imperative	Variance theory	Mixed				

Table 1 summarizes the methodological analyses of prior studies based on Markus and Robey's "causal structure" framework.

Causal Agency. Table 1 indicates prior studies are mainly from technological imperative perspective. The major efforts are to identify the antecedents of the individual's perceptions, say the antecedents of attitude, perceived usefulness and perceived ease of use (e.g. Venkatesh and Davis, 1996; Venkatesh and Davis, 2000). For example, in the original TAM, the technical factors are described as "external factors" that can influence user's perceptions and subsequently influence their attitude. In TAM, the relation between technology and individuals, and organizations is one-way, just from technology to individuals. We argue that the interaction between technological sprit and organizational structures may influence individual perceptions. The emergent perspective may be more appropriate for technology acceptance research.

Logical Structure. While most prior research used variance theories, there were still some researchers who used process theories. For example, Venkatesh and Davis (2000) conducted a longitudinal research and found the changing effects of the antecedents of perceived usefulness. One of the major advantages of the process theory is that it retains the empirical fidelity of the emergent perspective when preserving the

predictability and generalizability (Markus and Robey, 1988). Considering the complexity of human behavior, hence, process theories may be more appropriate for the research on user technology acceptance.

Level of Analysis. Prior research mainly focuses on individual perception at the micro-level of analysis. Sometimes, they took contextual factors into account (e.g. Taylor and Todd, 1995b; Venkatesh and Morris, 2000; Chau and Hu, 2002a; 2002b). 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). So the mixed-level of analysis should be appropriate to bridge the gaps between organizational and individual concepts.

We summarize the old and new methodologies in Figure 1. The solid line represents the new perspective suggested in this study and the dashed lines represent the perspective 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.

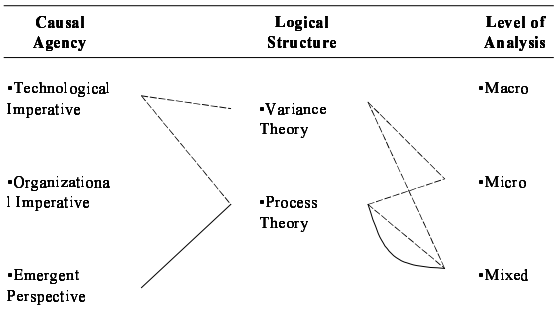

Figure 1: The mapping of old and new methodologies

4. An New Approach and Propositions

We outline the new model in Figure 2, which is based on the new methodological perspective. Three ovals represent the three basic units in the approach, technology, organization, and individuals. Emergent perspective is reflected by the three double arrows in the middle of Figure 2, which means the interactions among technologies, organizations, and individuals. The experience/feedbacks arrows reflect the process theories. The inclusion of individual and organizations in this new approach simultaneously means the mixed-level of analysis. The links between the technology acceptance model (TAM), task-technology fit (TTF) and computer self-efficacy (CSE), three notable models of user technology acceptance, can be easily identified in the new approach.

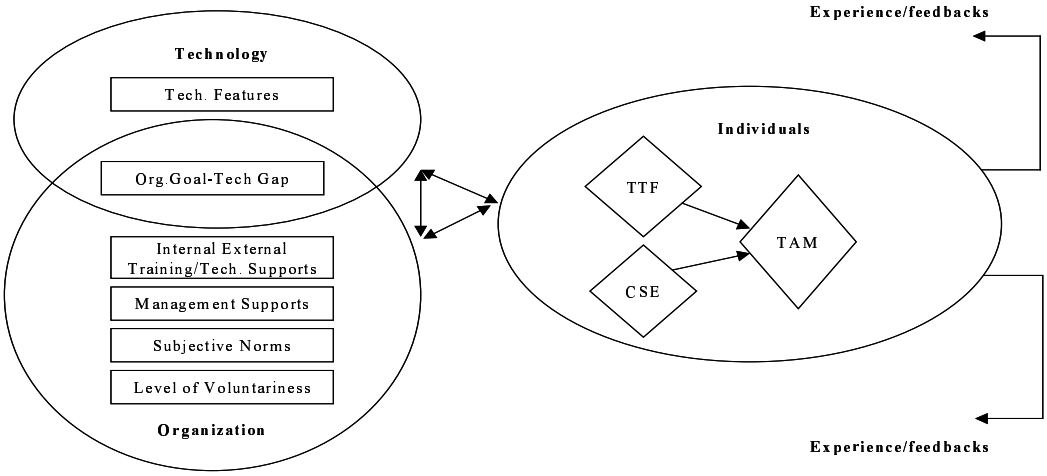

Figure 2: The new model of user technology acceptance

This new approach leads to several propositions as follows.

4.1. 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 refer to the implementation gaps and transitional supports respectively in Chau's research (1996), influence user acceptance. Organizational contingency theories (Galbraith, 1973; Van de Ven and Delbecq, 1974; Van de Ven and Brazin, 1985) can provide some implications. While contingency theorists argue that organization's structure must "fit" its organizational context, the technology must fit organizational goals similarly. The gaps between organizational goals and technological functions influence usefulness and ease of use. Therefore, we propose that:

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

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

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

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

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

Two direct methods to bridge the gaps of technological readiness are external and internal trainings and supports, which are also confirmed to have significant effects on perceived usefulness and perceived ease of use (Igbaria et al., 1997). Igbaria and his colleagues (1997) argued that internal training significantly influences perceived usefulness and external training influences on perceived ease of use, while external supports have effects on both perceived usefulness and perceived ease of use.

P1-c: Internal training is positively related to perceived usefulness.

P1-d: External training is positively related to perceived ease of use.

P1-e: External technological supports are

positively related to both 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, and also the most obvious, one 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. First, based on their own tasks requirements, even images, they may exert their influences at the stages of system design and implementation. Secondly, users' experience and lessons gained from actual use will influence the further improvement of technologies, which can enhance the users' future acceptance. We will discuss the second one later. Here we propose that:

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

4.2. Propositions from process theories

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

Experience is a major issue associated with the role of time. 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, 1995b). However, the relationships within TAM are different between experienced and inexperienced users. Based on the analytical literature review, experience may influence relationships between (1) behavioral intention and actual usage, (2) perceived usefulness and behavioral intention, (Taylor and Todd, 1995b), (3) subjective norms and perceived usefulness (Venkatesh and Davis, 2000), and (4) external technological supports and EOU (Igbaria et al., 1997). Therefore, we propose that:

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

A similar concept refers to the feedback in Goodhue and Thompson' research (1995). Once a technology is used, there will inevitably be various feedbacks to it, which may be considered for the further improvement (Goodhue and Thompson, 1995). The individuals may also learn from the experience better ways of utilizing the technology, improving individual-technology fit, and subsequently the overall task-technology fit (Goodhue and Thompson, 1995). Therefore, there are two channels through which feedbacks influence user technology acceptance. One is the effect of experience on individuals and the other is the one on the technology, both of which can influence task-technology fit (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 et al., 1999). Experience has been confirmed to have significant effects on CSE (Hill et al., 1987; Compeau and Higgins, 1995b; Agarwal, et al., 2000; Johnson and Marakas, 2000). As for the effect of experience on technology, we can go back to Proposition 1-h, which proposes that the level of user involvement at the system design or implementation stage is positively related to the user acceptance. Therefore based on the experience from actual usage, users can exert their influences directly on system improvement. We summarize the above discussions and propose:

P2-b: Experience can enhance user

computer self-efficacy.

P2-c: Positive feedbacks can enhance following task-technology fit and subsequently can influence future technology acceptance.

The second focus concerning process theories is about the relationship between outcomes and the necessary conditions. According to the process theories, outcomes may or may not happen even if all the contingent conditions are met. 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 no antecedents, the outcome will not occur". This idea will be reflected in all the propositions in this study. We use propositions like " X has positive/negative effects on Y" or " X positively/negatively influence Y" rather than "the more X, the more Y", which is a typically pattern of variance theories.

4.3. Propositions from 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 structure and in turn, the new reshaped organizational structures will influence individual perceptions (Majchrzak et al., 2000).

Management support is an example of the effect of organizational hierarchy on individual perceptions. Management support was considered as a type of transitional supports by Chau (1996), which was considered to have positive impacts on perceived usefulness and perceived ease of use. Therefore:

P3-a: Management supports have positive effects on perceived usefulness.

P3-b: Management supports have positive effects on perceived ease of use.

Subjective norms (SNs) are 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). Subjective norms have relatively unstable effects on user technology acceptance (Sun, 2003). Therefore, the effects of subjective norms are not consistent across prior studies. Experience is considered as moderating factors that may account for the inconsistency (Sun, 2003). So we suggest that:

P3-c: SN has a significant effect on user technology acceptance for inexperienced users.

P3-d: SN does not have a significant effect on user technology acceptance 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 Benbasat, 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 context and therefore the level of voluntariness is considered to be a moderating factor (e.g. Venkatesh and Davis, 2000). Suggested by these results, we propose that:

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

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5. Discussions and Conclusion

Just as the original TAM itself was adapted from a psychological model on individuals, theory of reasoned action (Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1980), the studies stemming from TAM are mainly from the individual perspective. Based on Markus and Robey's "causal structure" framework, the methodology of prior user technology acceptance research can be described as "technological imperative - variance- micro or mixed level of analysis" or "technological imperative - process – micro or mixed level of analysis". This study argues that a combination of "emergent perspective - process theory - mixed-level of analysis" should be a more appropriate methodology to analyze user technology acceptance, which can at least partially explain the inconsistencies existing in the prior research. Furthermore, from this perspective we can derive the propositions about not only the existing moderating factors identified by prior researchers but also some new relationships.

Our methodological review and analysis has research and practical implications. For researchers, we provide a different perspective from which user technology acceptance is described as a dynamic process, which is characterized by the interaction between technological and organizational structures. This study draws on many prior studies, such as computer self-efficacy (CSE, Compeau and Higgins, 1995a; 1995b) and task-technology fit model (TTF, Goodhue, 1995; Goodhue and Thompson, 1995; Zigurs and Buckland, 1998), but reassembles them in a novel way. Therefore this study can be seen as an attempt to apply a methodological perspective for traditional research on individual's technology acceptance.

For practitioners, this review and analysis suggests that more technological and organizational support is needed to promote user technology acceptance. And more, user perception can also change the technological and organizational structures. Along with the accumulation of experience, user perception of the same technology may also change. So taking a more dynamic perspective will benefit the understanding of user technology acceptance. Another implication is from the process theories. Implied by process theories, the technology acceptance cannot be completely predicted by just some predictors. Under same conditions, users may or may not accept the technology due to some random events that cannot be predicted and cannot always be avoided proactively.

Future research may have several potential directions. Our work focuses on the technological and organizational contexts. Human beings, however, are more complex. For example, research on user technology acceptance should pay attention to other aspects of human side. To date, the research, including this study, mainly uses cognitive beliefs as the basic antecedents of user's attitude. Derived from theory of reasoned action, perceived usefulness and perceived ease of use are all based on user's beliefs. The psychological research, however, finds that another factor, affect, may have independent influence on user attitude (Veenhoven, 1991; Weiss, 1999). Fortunately, some researchers, from human computer interaction perspective, have already noticed this.

> *"As non-rational human beings, we have a full range of opportunities to interact with technologies for different purposes in non-rational or bounded-rational ways. The holistic view of HCI (e.g. user acceptance) should include cognitive, emotional, and affective aspects in all possible interactions humans have with technologies." (Zhang et al., 2002, p. 346)*

Therefore the research on user acceptance should see human beings from a more comprehensive perspective.

Another possible direction is the individual and organization technology acceptance/adoption in a broader context. Many organizational theories may serve this goal. An integrated view of the use of

computers within organizational, social and global contexts is the current trend (Zhang et al., 2002). Therefore, considering user technology acceptance in broader organizational and technological contexts and considering it as a process are important for further research and practices.

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