



Information technology adoption behavior life cycle: Toward a Technology Continuance Theory (TCT)

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ABSTRACT

For over a decade, researchers have devoted much effort to construct theoretical models, such as the Technology Acceptance Model (TAM) and the Expectation Confirmation Model (ECM) for explaining and predicting user behavior in IS acceptance and continuance. Another model, the Cognitive Model (COG), was proposed for continuance behavior; it combines some of the variables used in both TAM and ECM. This study applied the technique of structured equation modeling with multiple group analysis to compare the TAM, ECM, and COG models. Results indicate that TAM, ECM, and COG have quite different assumptions about the underlying constructs that dictate user behavior and thus have different explanatory powers. The six constructs in the three models were synthesized to propose a new Technology Continuance Theory (TCT). A major contribution of TCT is that it combines two central constructs: attitude and satisfaction into one continuance model, and has applicability for users at different stages of the adoption life cycle, i.e., initial, short-term and long-term users. The TCT represents a substantial improvement over the TAM, ECM and COG models in terms of both breadth of applicability and explanatory power.

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1. Introduction

Over the years, information system (IS) usage has been a prominent topic in IS research. Prior efforts have sought to establish a theoretical base by explicating the determinants and mechanisms of users' adoption decisions. It is widely believed that the adoption process influences successful use of information systems (Grover et al., 1998; Karahanna, Straub, & Chervany, 1999). Many scholars have investigated the factors that influence the diffusion of IS innovations in organizations (e.g., Gallivan, 2001; Rogers, 2003; Swanson & Ramiller, 2004; Zhu, Kraemer, & Xu, 2006). Others have proposed psychological models for explaining and predicting users' behavior toward IS adoption at the individual level (e.g., Bhattacherjee, 2001; Bhattacherjee & Premkumar, 2004; Davis, Bagozzi, & Warshaw, 1989; Venkatesh & Davis, 2000; Venkatesh et al., 2003). These two streams of research suggest that the determinants and mechanisms for an individual's adoption decision may vary from stage to stage during the lifecycle of IS usage, i.e., at initial adoption and then subsequent stages of continued usage. Thus using the same or misdirected managerial tactics to facilitate adoption behavior across various stages may result in negative consequences and reduced IS effectiveness. Though different behavioral models (Karahanna, Straub, & Chervany, 1999; Jasperson, Carter, & Zmud, 2005) have been recognized as relevant to user adoption behavior at different

stages, what is lacking is a clear comparison of these models in terms of their theoretical underpinning and application practices. Without a clear understanding of the differences in users' adoption behavior over time, both scholars and practitioners will not be able to effectively manage the issues related to system design, individual cognition, and organizational actions.

The Technology Acceptance Model (TAM) (Davis, 1986; Davis et al., 1989) has dominated IS "use" research and has led to much exploration and widespread discussion over its application and extensions (e.g., Lai & Li, 2005; Shih, 2004b). In more recent years, the expectation confirmation model (ECM) (Bhattacherjee, 2001) was proposed to describe user's behavior in "continue to use" an information system. ECM was adapted from the consumer satisfaction/dissatisfaction model (CS/D) (Churchill & Suprenant, 1982; Oliver, 1981; Oliver & Burke, 1999; Tse & Wilton, 1988) that was originally designed in marketing research to model consumer's repurchase behavior. TAM with its focus on initial acceptance of an IS, theorizes that system use is directly determined by behavioral intention to use, and in turn motivated by the user's attitude toward system use. At the same time, ECM's objective is to evaluate an individual's continuance and loyalty for system use and argues that user satisfaction is the most important requirement determining a user's intention for continued use. While TAM has enjoyed widespread use and related literature has grown tremendously, there has been limited activity in ECM, post-adoption behavior and IS continuance research (Bhattacherjee, 2001; Bhattacherjee & Premkumar, 2004). Many studies have been conducted to verify TAM with diverse empirical data and in various application con-

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texts (Shih, 2004a; Vijayasarathy, 2003; Yu et al., 2005), although the results have not always been consistent.

In comparing the theoretical underpinnings and application practices of TAM and ECM, three major differences can be found. First, while TAM has been applied to examine continuance and post-adoption behavior (Gefen, Karahanna, & Straub, 2003; Karahanna et al., 1999; Shih, 2004b; Taylor & Todd, 1995), its emphasis is on examining variables that lead to initial acceptance. On the contrary, ECM focuses on factors that influence retention and loyalty, as the long-term viability of an IS and success depends on continued use rather than first-time use alone (Bhattacharjee, 2001). Second, TAM proposes that the behavior toward system use can be determined by the user's attitude. However, ECM hypothesizes that IS continuance is primarily affected by user satisfaction. Many theorists believe that conceptually satisfaction and attitude are two distinct constructs (Oliver, 1980; Oliver, 1981; Tse & Wilton, 1988). Third, TAM considers two salient beliefs: perceived usefulness and perceived ease of use as underlying motivators affecting user's attitude and intention toward behavior. These behavioral beliefs are highly related to outcome expectations (Ajzen, 1991; Bandura, 1986; Davis et al., 1989). Thus TAM only adopts user expectations, usually measured in a single time period, to explain and predict behavioral intention. On the other hand, ECM is based on CS/D which posits that user satisfaction has a strong relationship with disconfirmation, which is a function of the difference between user expectations and perceived performance. According to CS/D, a user's expectation must be measured before system use whereas perceived performance is measured after the experience. However, CS/D ignores potential changes in outcome expectations across the accumulation of user's experience and the impact on user's psychological state and cognitive process. ECM replaces pre-consumption expectations with post-consumption expectations and postulates that satisfaction is a function of expectations and confirmation.

Although many theoretical differences exist between TAM and ECM, no empirical study, to our knowledge, has examined the influences of these differences on explaining and predicting users' psychological states and behavior. In comparing them, many interesting issues are worthy of exploring. For example, which model is more powerful or more suitable? How do the predictive power of the models change from initial acceptance of IS to continued use? Is it appropriate to apply TAM to predict and explain user behavior toward technology continuance? Note that while TAM uses attitude and ECM uses satisfaction, an earlier landmark paper by Oliver (1980) used both attitude and satisfaction as antecedents to intention. In fact, in the Cognitive Model (COG) proposed by Oliver, satisfaction is postulated as an antecedent to post-exposure attitude. Is it possible to develop a hybrid model which combines attitude and satisfaction and relevant parts of TAM and ECM, and has higher explanatory power for describing user behavior toward technology continuance?

We address the above questions in this study. The study investigates differences in model descriptions, model-fit, and explanatory power of the three intention models: TAM, ECM, and COG. Subsequently, we develop an enhanced theoretical model, called Technology Continuance Theory (TCT) which integrates the three existing models, for representing and explaining user behavior toward technology continuance. Specifically, the objectives of the study are:

1. Compare the three models: TAM, ECM, and COG. Test their hypotheses, and compare their path coefficients and explanatory powers.
2. Compare the three models across various stages of IS continuance. The three stages included are: initial adopters, short-term users, and long-term users.

3. Propose an enhanced Technology Continuance Theory (TCT) based on the characteristics of TAM, ECM and COG.
4. Evaluate the model fit and explanatory power of TCT, and compare it with TAM, ECM, and COG.

2. Literature review

2.1. Technology Acceptance Model

In the late 1980s, the TAM was developed for the IS discipline (Davis, 1986; Davis et al., 1989). It was based on the theory of reasoned action (Fishbein & Ajzen, 1975), an intention theory that has been widely accepted for several decades. TAM received wide attention from IS researchers for at least three reasons. First, it has a strong foundation in psychological theory (Chau, 1996; Taylor & Todd, 1995). Second, it is parsimonious and can be used as a guideline to develop a successful information system (Venkatesh & Davis, 2000). Third, past stream of research supports the robustness of the model across time, setting, populations, and technologies (Venkatesh & Davis, 2000).

TAM hypothesizes that actual system use is determined by users' behavioral intention to use (BI), which in turn is influenced by users' attitudes toward using (A). Attitude and behavioral intention are two internal psychological variables that have direct effects on user behavior. By definition, behavioral intention is a measure of the strength of one's willingness to try and exert while performing certain behavior (Ajzen, 1991). Attitude refers to "the degree of a person's positive or negative feelings about performing the target behavior (Davis et al., 1989, p. 984)." TAM postulates that the internal variables are motivated by two external factors regarding system design characteristics: perceived usefulness (PU) and perceived ease of use (PEOU). PEOU can directly affect both attitude and PU. PU is defined as "the prospective user's subjective probability that using a specific application system will increase job performance (Davis et al., 1989, p. 985)." PEOU refers to "the degree to which the prospective user expects the target system to be free of effort (Davis et al., 1989, p. 985)." An additional relationship from PU to BI is based on the assumption that intention to use can be based on an expected improvement in job performance regardless of attitude. TAM and its relationships are shown later in Fig. 3.

Several attempts have been made to enhance the explanatory and predictive power of TAM. Taylor and Todd (1995) integrated the Theory of Planned Behavior (TPB) (Ajzen, 1991) to TAM and proposed a decomposed version of TPB. Venkatesh and Davis (2000) proposed an extended model of TAM which incorporates social influence processes and cognitive instrumental processes. Several researchers have integrated variables from the Innovation Diffusion Theory (Rogers, 2003) to TAM or other intention models. Recently, TAM was combined with four core determinants of IT usage (Venkatesh et al., 2003). On an ad hoc basis, constructs such as trust, perceived enjoyment, training, privacy, security, compatibility, and self-efficacy have been added to the basic TAM (Mao & Palvia, 2006; Shih, 2004a; Vijayasarathy, 2003; Yu et al., 2005). Despite reported improvement in the explanatory power of these new models, IS researchers have maintained their interest in TAM due to its parsimony and replicability (Lai & Li, 2005). TAM has even been applied to examine continuance and post-adoption behavior (Gefen et al., 2003; Karahanna et al., 1999; Taylor & Todd, 1995).

2.2. Expectation Confirmation Model

What shifts the attention of users from initial acceptance to continued use is generally explained by the CS/D, an alias of the "expectation disconfirmation model" (Oliver, 1993; Spreng & Chiou, 2002; Van Montfort, Masurel, & Van Rijn, 2000) and

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