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Technological-Personal-Environmental (TPE) Framework: A Conceptual Model for Technology Acceptance at the Individual Level

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ABSTRACT

This paper describes the development of the Technological-Personal-Environmental (TPE) framework, which explains individuals' behaviors of technology acceptance. We argue that existing individual-level technology acceptance theories provide a valuable, but incomplete, understanding of individuals' technology acceptance. By synthesizing extant technology acceptance models and theories, the proposed TPE delineates the individual-level technology acceptance from technological, personal, and environmental aspects. The proposed framework provides a wider angle to investigate individual-level technology acceptance.

INTRODUCTION

In the literature, there are several theories and models proposed for technology acceptance. In general, there are two streams of those theories and models; one is with assumption of rational decision and utility maximization and another one is irrational decision due to social pressure and imitation behaviors. Some theories and models integrate elements from both streams. On the other hand, the theories and models can also be classified into the firm level and individual level, which were proposed to examine technology acceptance of organizations and of individuals, respectively.

Technological-Organizational-Environmental (TOE) framework is a widely used model for examining technology acceptance at the firm level. This model is comprehensive, consisting factors related to three aspects -- technological, organizational, and environmental. Although there are several technology acceptance models and theories for technology acceptance at the individual level, those models are not comprehensive as TOE. However, TOE in nature was designed for technology acceptance at the firm level. Therefore, this paper aims to propose an overarching model, which on one hand inherits the comprehensiveness of TOE and on the other hand is adapted for technology acceptance at the individual level.

In the following sections, we first review the related theories and models of technology acceptance, followed by the newly proposed model with detailed discussions on the potential variables in the model. Then a discussion is presented.

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LITERATURE REVIEW

Technology Acceptance Theories

In the literature, there are several technology acceptance theories. The Theory of Reasoned Action (TRA), proposed by Fishbein and Ajzen (1975), posits that behavioral intentions are determined by an individual's attitude toward the behavior and subjective norms. TRA has two extensions -- Theory of Planned Behavior (TPB) and Technology Acceptance Model (TAM). TPB, proposed by Ajzen (1991), posits that behavioral intentions are influenced by an individual's attitude toward the behavior, the subjective norms, and the individual's perception of behavioral control. TAM is an adaptation of TRA in the information systems (IS) field. The model posits that technology acceptance is influenced by perceived usefulness, perceived ease of use and subjective norm (Davis, 1989). In Roger's (1962) and Moore and Benbasat's (1991) Innovation Diffusion Theory (IDT), relative advantage, ease of use, and image are postulated to influence individual technology acceptance. Technology Readiness Index (TRI), proposed by Parasuraman (2000), posits that an individual's technology acceptance is "an interplay between drivers (optimism, innovativeness) and inhibitors (discomfort, insecurity) of technology readiness" (p.317). However, only personal factors, rather than any social factors, are considered in this model.

All of these models can be categorized as rational choice models, which emphasize self-interest, conscious decision making, and economic optimization. They assume that technology acceptance processes are choice procedures which are systematically conducted and follow a rational path based upon perfect information (Abrahamson, 1991). However, House and Singh (1987) argued that "most assumptions of rational choice theory of decision making are frequently violated in practice" (p.702), and that "much of the empirical work on decision making suggests that decisions are made in much less rational ways than specified by rational choice theory" (p.707). Furthermore, in the real world it is impossible to obtain perfect information, thus bringing forth uncertainty and jeopardizing the anticipation of the decision consequences.

Social Factors

Although most of the models discussed heretofore consider various social factors, they are generally fragmented and there is a lack of specific focus on such issue (McCarthy et al., 2004; Venkatesh *et al.*, 2003). Individuals are social actors, who are likely to develop their beliefs, attitudes and behaviors consistent with those of their environments, thus they are subject to environmental pressures and likely to make decisions without much concern for rationality (Bandura, 1977; Fadil et al., 2009; Granovetter, 1973). In addition, decision makers in general are lack of complete and symmetric information, so disregard their private but limited knowledge, in favor of following someone else's decision. The underlying logic of the influences of social factors on individuals' attitudes and behaviors towards technology acceptance is that the social factors may have built up a collection of implicit rules, which may be both imposed on and upheld by the individuals' attitudes and behaviors. DiMaggio and Powell (1983) contended that technology acceptance may become imitation in pursuit of legitimacy. In this way, individuals' acceptance decisions are not only because of their individual assessments of the technology's efficiency or returns, but also because of a pressure caused by the sheer number of individuals

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that have already adopted this technology, even when their private information suggests doing something quite different (Abrahamson & Rosenkopf, 1993).

Technological-Organizational-Environmental (TOE) Framework

Tornatzky and Fleisher's (1990) Technological-Organizational-Environmental (TOE) framework, a firm-level technology acceptance model, examines three major potential influences on technology acceptance: technological, organizational, and environmental. The technological context examines internal and external technologies, including equipment and processes. The organizational context covers various characteristics of the organization, including structure, resource availability, and autonomy. The environmental context deals with the industry, competitive setting, and regulatory issues.

A number of researchers have employed the TOE framework in various settings, including Electronic Data Interchange (Kuan & Chau, 2001), open systems (Chau, 1997), Internet (Forman, 2005), and electronic procurement systems (Soares-Aguiar & Palma-dos-Reis, 2008).

THE PROPOSED MODEL

By design, the TOE framework addresses technology acceptance in organizational settings. TOE framework integrates technological, organizational and environmental factors, thus providing more comprehensive coverage than other models. However, in nature TOE was designed for organizational contexts, in which organizational factors are explicitly considered. The organizational factors incorporated into TOE are not appropriate for technology acceptance at the individual level. Instead, personal factors should be considered for technology acceptance at the individual level.

On this basis, this paper proposes a derivation of the TOE framework that investigates the influences of technological, personal, and environmental contexts on technology acceptance at the individual level. We coined this framework as Technology-Personal-Environmental (TPE) model.

It should be noted that although TPE model shares inherent properties of TOE, all variables of TPE should be adapted to be appropriate for the individual level. To be brief, the technological context may have variables such as the individual's self-efficacy, technical needs, and perceived usefulness. The personal context includes the individual's personality properties, such as extraversion, compatibility, and risk aversion. The environmental context consists of social factors and other imitation and institutional factors. It should be noted that TPE, same as TOE, only roughly categorizes the variables into technological, personal, and environmental; researchers may use different sets of variables for each categories on the basis of research subjects and theory boundaries. The TPE model is depicted in Figure 1 and discussed in details as follows.

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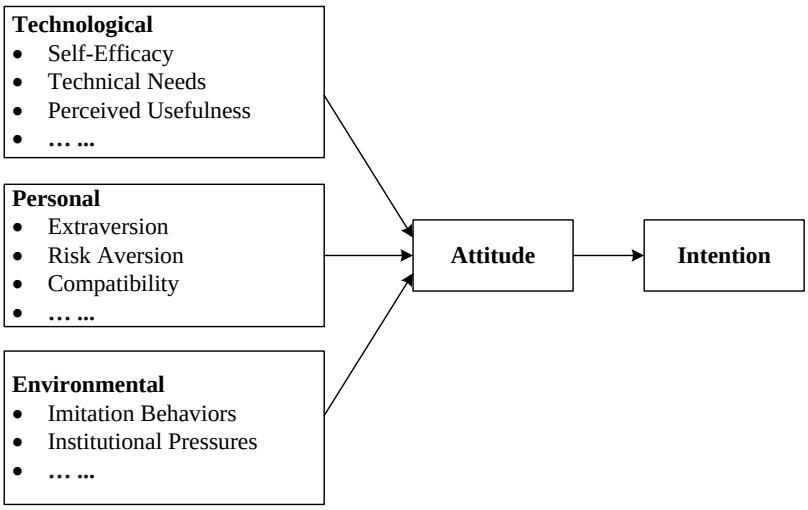
Figure 1: The Conceptual Model.



Technological Context

All variables related to technology are categorized into this context. The possible variables, as suggested by the literature, include such as self-efficacy, technical needs, perceived usefulness, and perceived ease of use.

Self-efficacy: It addresses the user's perception of his or her ability to use a computer to accomplish a specific task (Venkatesh & Davis, 2000). In general, when individuals are confident with their technology ability, they are more likely to accept new technologies. This linkage has been widely reported in the literature. For example, Tan and Teo (2000) and Lee and Kozar (2008) found that self-efficacy was significantly related to a user's intention of using Internet banking and anti-spyware software, respectively.

Technical needs: technology acceptance in general derives from needs. The greater the need for technologies, the more motivated the individuals are to accept the technologies. The underlying logic for this argument lies on expected utility theory, which posits that the decision makers are to maximize the utility the decision may cause. Technical needs present the utility potentials the technology acceptance may cause. In the literature, numerous studies reported that utility potentials have significant influences on attitude towards technology acceptance (Chen et al., 2010; Hsieh *et al.*, 2008).

Perceived Usefulness was defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p320). The literature has identified perceived usefulness as an important determinant of technology acceptance (Lee et al., 2003). For example, Lee, Kozar, and Larsen (2003) found that 74 studies reported a positive relationship between perceived usefulness and intention.

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Personal Context

The personal context may include variables related to the individual's personalities and other individual's properties. Possible variables include such as personality (e.g., extraversion), risk aversion, and values. These personal variables were not well examined in the previous studies (McElroy et al., 2007).

In the literature, personality traits can influence the selection of information technologies (Korzaan & Boswell, 2008). For example, extraverted persons often exhibit traits such as assurance, dominance, and the willingness to take charge, thus extraversion has also been positively linked to technology skills (Clark et al., 2003).

Risk appetite determines the tolerance for risk one possesses, thus influencing behaviors one engages in to reduce risk (Liang & Xue, 2009). Thus, risk-averse individuals are more likely to accept new technologies.

According to Tornatzky and Klein 's (1990) meta-analysis of innovation adoption, an innovation is more likely to be accepted when it is compatible with individuals' value system. For example, Tan and Teo (2000) found that compatibility was a significant factor in determining the likelihood of accepting Internet banking.

Environmental Context

Environmental context may include some social variables. Venkatesh et al. (2003) define social influence as "the individual's internalization of the reference group's subjective culture, and specific interpersonal agreements that the individual has made with others, in specific social situations" (p.430). There are two related theories that can provide guidance to conceptualize and operationalize social variables. One is institution theory and another one is imitation theory.

The institutional theory posits that an individual's beliefs, attitudes, and behaviors are strongly influenced by the institutions (Emdad et al., 2009; Scott, 2001), which are "social structures that have attained a high degree of resilience" (Scott, 2004, p.48). The institutional theory suggests that institutions create constraints that are locally rational in an economic sense, but collectively suboptimal (DiMaggio & Powell, 1983). Although the institutional theory has been primarily applied at the organizational level (e.g., Liang et al., 2007), it is also applicable at the individual level (e.g., Shi *et al.*, 2008), as Scott (2001) pointed out that institutions can operate at the level of "localized interpersonal relationships" (p.48). Therefore, we believe the conceptualized and operationalized institution variables could be included into the TPE model. DiMaggio and Powell (1983) and Scott (2001) suggested three institutional pressures – coercive, normative and mimetic, as detailed as follows.

Coercive pressures are defined as pressures from more powerful actors. There are two types of coercive pressures – competition and regulation. Competitive pressure is from the threat of losing competitive advantage. Regulatory pressure is from government agencies and professional regulatory bodies (Harcourt et al., 2005). These pressures may force individuals to adopt the same attitudes, behaviors and practices (DiMaggio & Powell, 1983).

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Normative pressures occur when individuals voluntarily, but unconsciously, copy same attitudes, behaviors, and practices of the others. The attitudes, behaviors, and practices may be so well established that become legitimized as deemed as the only 'right' way things should be done (Harcourt et al., 2005). The normative pressures may lead individuals who have not adopted the technology to experience dissonance and hence discomfort (DiMaggio & Powell, 1983). It should be noted that this type of behaviors are not coerced by any powerful actors, neither is it conscious.

Mimetic pressures force individuals to seek examples to voluntarily and consciously follow the same practices and behaviors of other successful and high-status individuals (DiMaggio & Powell, 1983). This mimic is due to the belief that actions taken by successful individuals are more likely to yield positive outcomes.

Similarly, imitation theory also addresses why social individuals imitate each other. There are also three types of imitation behaviors, which overlap with institution pressures to certain degree. The three types of imitation are as follows:

Trait-based imitation: Individuals often imitate other individuals who they view as high profile (e.g. famous, important, & successful), because it is what they are striving to achieve (Casson, 1997). This type of imitation is similar with mimetic pressure in the institution theory.

Frequency-based imitation: individuals are more likely to imitate a behavior if that behaviors has been taken by a large number of other individuals (Haunschild & Miner, 1997). The sheer large number may build legitimacy, which may compel a non-adopter to adopt the same behaviors (DiMaggio & Powell, 1983; Tolbert & Zucker, 1983), even when these behaviors are not necessarily suitable. This type of imitation is similar with normative pressure in the institution theory.

Outcome-based imitation: It is a more technical consideration than a social one. Levitt and March (1988) argued that individuals can imitate behaviors based on their perceived outcome. It is a form of vicarious learning (Haunschild & Miner, 1997), in which individuals monitor the outcomes of others who undertake the behaviors.

Attitude and Intention

Attitude and Intention are also included in our TPE model. Attitude and intention are two widely examined variables in the literature of technology acceptance. Attitude refers to "the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question" (Ajzen, 1991, p.188). Several technology acceptance theories and models posit that individual social behavior is motivated by an individual's behavioral attitudes. For example, TAM postulates the attitudinal explanations of intention to use a specific technology or service (Davis, 1989). TPB also posits that attitude is an essential underlying determinant of intention (Ajzen, 1991). This proposition has accumulated wide empirical support in various IS/IT contexts, such as information and communication technologies, e-banking, e-commerce, and information systems (e.g., Chau & Lai, 2003; Cheng et al., 2006)

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DISCUSSIONS AND CONCLUSION

By synthesizing a multitude of technology acceptance models and theories and the relevant literature, this paper develops an overarching framework for technology acceptance at the individual model. The proposed model integrates variables from three dimensions -- technological, personal, and environmental (TPE), which largely inherits from TOE, a comprehensive technology acceptance model at the firm level. Potential variables of each dimension are also illustrated by discussing existing individual-level technology acceptance models and other related theories (e.g., institutional theory & imitation theory).

It should be noted the paper does not exhaustively enumerate all potential variables of each dimensions. Other variables could be included on the basis of the research objectives and theoretical boundaries. For example, individual's cultural characteristics may be included as personal variables (Loiacono & Lin, 2005; Srite & Karahanna, 2006).

The proposed framework contributes to the literature by offering a more comprehensive technology acceptance model at the individual model. The model also adapts related firm-level model (i.e., TOE) and theory (i.e., institutional theory) to the individual level. The model may provide a wider angle to investigate individual-level technology acceptance. This paper breaks ground for future research to empirically test or theoretically extend TPE, which provides exciting opportunities to enhance our understanding of individual-level technology acceptance.

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