Journal of the Association for Information Systems
JAIS

Research Article

Modeling Citizen Satisfaction with Mandatory Adoption of an E-Government Technology

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Abstract

While technology adoption is a major stream of research in information systems, few studies have examined the antecedents and consequences of mandatory adoption of technologies. To address this gap, we develop and test a model of mandatory citizen adoption of an e-government technology. Based on a framework that outlines the key stages associated with the launch of technology products, we identify various external factors as antecedents of four key technology adoption variables from the unified theory of acceptance and use of technology (UTAUT), i.e., performance expectancy, effort expectancy, social influence, and facilitating conditions, which ultimately impact citizen satisfaction. The four stages of technology launch and the salient antecedents in each stage are: (1) market preparation stage—awareness; (2) targeting stage—compatibility and self-efficacy; (3) positioning stage—flexibility and avoidance of personal interaction; and (4) execution stage—trust, convenience, and assistance. We test our model in a two-stage survey of 1,179 Hong Kong citizens, before and after they were issued a mandatory smart card to access e-government services. We find that the various factors tied to the different stages in launching the technology predict key technology adoption variables that, in turn, predict citizen satisfaction with e-government technology. We discuss the theoretical and practical implications for governments implementing technologies whose use by citizens is mandated.

Keywords: *Technology Adoption, Mandatory Adoption, Electronic Government, New Product Launch, Citizen Satisfaction, Smart Card, UTAUT*

* Bernard Tan was the accepting senior editor. Weiling Ke and Choon-Ling Sia were the reviewers. This article was submitted on May 4, 2009 and went through two revisions.

Volume 11, Issue 10, pp. *519-549* October 2010

1. Introduction

Research on individual-level technology adoption is one of the most mature streams in information systems (IS) research (Venkatesh et al., 2007). While prior technology adoption research has been conducted primarily in environments of voluntary adoption, the applicability of previous findings to the mandatory use context is unclear. Some research has suggested that the underlying relationships in traditional technology adoption models could be different in the context of mandatory technologies (e.g., Brown et al., 2002). Specifically, the relative importance of determinants of user acceptance, such as perceived usefulness and perceived ease of use in the technology acceptance model (TAM), may differ in a mandatory use setting (Brown et al., 2002). Other research shows that the effects of these determinants on behavioral intention are moderated by voluntariness of use (Venkatesh and Davis, 2000; Venkatesh et al., 2003; Wu and Lederer, 2009). Further, some researchers have noted that user satisfaction, rather than behavioral intention, is a more appropriate dependent variable in mandated use environments (Brown et al., 2002; Brown et al., 2008). While prior studies have recognized the distinction between voluntary and mandatory technology adoption, there is a paucity of research that has systematically examined technology adoption in the mandatory use context. The dearth of research is particularly noticeable in the context of consumers outside the workplace, as the typical assumption is that most consumer behaviors are voluntary (see Brown and Venkatesh, 2005).

One suggested way to extend the general theoretical models of technology adoption, such as TAM, to different contexts is to examine the antecedents of the more general predictors presented in these models (Venkatesh and Bala, 2008; Venkatesh et al., 2007). Modeling the antecedents can help identify interventions that lead to greater acceptance and more effective use of a technology (see Plouffe et al., 2001; Venkatesh and Bala, 2008), and provide insights into services management (Venkatesh, 2006). In view of this, we propose that the launch strategy of a new technology is relevant to user acceptance and satisfaction, especially when the use of the technology is mandatory. Drawing on Easingwood and Koustelos' (2000) framework for launching technology products, we suggest identifying factors related to different stages of launching technology products—i.e., market preparation, targeting, positioning, and execution—and integrating these specific factors with a general model of technology adoption. This approach is in line with prior research that views the implementation of an innovation as a stage-based process and examines factors facilitating different stages of the implementation process (Grover and Goslar, 1993). It helps identify salient factors that facilitate the design of strategies in different launching stages.

An interesting and important emerging context in which mandatory technology adoption by citizens can be studied is electronic government (e-government)—i.e., the delivery of government information and services through the Internet or other digital means (West, 2004). A major distinction between e-government and other online technologies, such as e-commerce, is that the use of certain e-government technologies is mandatory, rather than voluntary (Warkentin et al., 2002). One example of a mandated e-government technology is the use of smart cards for personal identification and access to public services (Bailey and Caidi, 2005; Ng-Kruelle et al., 2006; Smith, 2005). Against this backdrop, the key objective of this paper is to advance a theory of mandatory technology adoption. Using the context of e-government, this research identifies key external factors related to the four stages of launching technology products and presents an integrated model of citizens' mandatory adoption of an e-government technology. The findings of this research will not only help advance our understanding of mandatory technology adoption in general, but also provide insights into how to prepare citizens for the newly mandated e-government technology in particular.

2. Background

2.1 Prior Research on Technology Adoption

Prior research on technology adoption has employed a number of theoretical models to examine individual acceptance of technologies. This stream of research has culminated in the unified theory of acceptance and use of technology (UTAUT; Venkatesh et al., 2003) that synthesizes previous

adoption models. UTAUT presents four core determinants of user acceptance and use: performance expectancy, effort expectancy, social influence, and facilitating conditions. Venkatesh et al. (2003) define performance expectancy as the degree to which an individual believes that using the IS will help him or her to attain goals in job performance, and effort expectancy as the degree of ease associated with the use of the IS. They define social influence as the degree to which an individual perceives that important others believe he or she should use the new IS, and facilitating conditions as the degree to which an individual believes that organizational and technical infrastructure exists to support use of the IS. The generalizability of these determinants has been demonstrated by a number of studies on the adoption of different technologies, such as mobile services (Carlsson et al., 2006), radio frequency identification (RFID) technology (Chen et al., 2007), and electronic marketplaces (Wang et al., 2006). More importantly, performance expectancy, effort expectancy, social influence, and facilitating conditions have been found to be significant determinants of behavioral intention/use in mandatory settings (Venkatesh et al., 2003). This pattern of results across a variety of settings clearly demonstrates the generalizability of the four core determinants in UTAUT in predicting individual technology adoption.

While the majority of prior research has examined technology adoption in voluntary use contexts, Brown et al. (2002) noted that existing models are not appropriate for explaining technology acceptance in mandatory use contexts. In particular, Brown et al. (2002) indicated that the traditional notion of "use" is not the appropriate dependent variable in mandatory use settings because employees must use the system to perform their job functions and there are no other alternatives to using the system. Further, Brown et al. (2002) found that users' attitudes toward using a technology and their intentions to use that technology are unrelated in mandated use environments. They noted that intention to use a technology may be related more to other beliefs, such as the associated rewards and punishments, than to beliefs about the technology itself. Thus, examining intentions and their antecedents may cause organizations to focus on less relevant factors. Instead, user satisfaction, not behavioral intention to use the system, is the more appropriate dependent variable when the system in question is large scale and integrated, and its use is mandated (Brown et al., 2002; Brown et al., 2008). As user satisfaction is widely recognized as a key metric of IS success (DeLone and McLean, 1992), understanding factors, including expectations and experiences of using the system, that influence user satisfaction has important implications for organizations (Brown et al., 2008).

Taken together, previous studies have suggested that the four core determinants in UTAUT—i.e., performance expectancy, effort expectancy, social influence and facilitating conditions—are key general beliefs that influence user adoption (e.g., Venkatesh et al., 2003). However, previous studies on mandatory adoption of technology have often focused only on the core beliefs in general models, such as perceived usefulness and perceived ease of use (Brown et al., 2002; Brown et al., 2008). Little effort has been devoted to understanding technology adoption in a mandatory use context by identifying relevant antecedents of core constructs in general models. As a result, there is a need for research to investigate how specific antecedents could be identified and incorporated into the general models in a systematic manner.

2.2 Prior Research on Marketing Technology Products

The new product launch is a critical stage of any new product development process, and the success of the product depends heavily on how well marketing managers deal with the launch (Beard and Easingwood, 1996). Prior research has focused on developing strategies to market high-technology products (e.g., Beard and Easingwood, 1996; Easingwood and Koustelos, 2000; Easingwood et al., 2006; Hsieh and Tsai, 2007; Lee and O'Connor, 2003). A useful framework by Easingwood and Koustelos (2000) suggests that the launch of a new technology comprises four stages: (1) *market preparation,* in which markets are readied for the product's arrival; (2) *targeting,* in which promising sectors are identified; (3) *positioning,* in which the goal is to achieve competitive advantage; and (4) *execution,* in which the market is attacked and includes direct actions to build sales (Easingwood et al., 2006). Examples of strategies relevant to each of these four stages include providing pre-launch information, targeting innovative adopters, emphasizing technological superiority, and reducing the risk of adoption (Easingwood and Koustelos, 2000).

Similar to the launch of new technology, the deployment of e-government to the public is often considered to be a stage-based process (e.g., Ke and Wei, 2004; Layne and Lee, 2001; Rivera and Rogers, 2004; West, 2004). Despite the differences in the conceptualizations of stages in the deployment process, there is a general consensus in the literature that strategic plans should be carefully designed with respect to different stages. For example, in a case study of e-government deployment in Singapore, Ke and Wei (2004) discussed actions taken in different stages—e.g., publishing information online by government agencies in the initiation stage, bridging the digital divide through the provision of community self-service terminals in the infusion stage, and leveraging multiple agencies' knowledge to provide integrated services in the customization stage. This example clearly illustrates that the design of strategies should be tailored to different stages of deployment and is critical to the success of e-government. Prior research in marketing technology products (e.g., Easingwood and Koustelos, 2000) thus provides a basis to identify and classify the antecedents of citizens' mandatory adoption of e-government technology.

2.3 Prior Research on E-government

Along with the global diffusion of the Internet, e-government is actively being deployed throughout the world, as evidenced by the fact that nearly all countries have developed government websites by 2010 (United Nations, 2010). Many countries (e.g., U.K., U.S., Canada, Norway and Germany) have also launched multi-year programs to create more citizen-centered, effective and efficient governments using web technology (Accenture, 2004). The transformation of traditional public services to e-government services has many benefits, including cost-effective service delivery, administrative cost reductions, a single integrated view of citizens across all government services, and faster adaptation to meet citizens' needs (Akman et al., 2005).

Prior research on e-government has primarily focused on the deployment of e-government technology to public and private organizations (e.g., Chu et al., 2004; Moon, 2002; Moon and Norris, 2005; Norris and Moon, 2005; Vonk et al., 2007), as well as to the general public (e.g., Fu et al., 2004; Wang, 2003). Particularly relevant to the current study, prior research on the deployment of e-government to the public has examined a number of e-government technologies, such as government websites (e.g., Cullen and Houghton, 2000), online tax-filing (e.g., Carter and Bélanger, 2005; Fu et al., 2004; Hu et al., 2009; Wang, 2003), and general electronic public services (e.g., Gilbert et al., 2004).

In some studies, researchers have focused on examining the factors that drive citizens' adoption and use of e-government services. These studies regard e-government as a technological innovation and leverage the adoption models commonly used in IS research, such as TAM. For instance, Carter and Bélanger (2005) integrated constructs from TAM, innovation diffusion theory (IDT), and web trust models to examine factors that influence citizens' adoption of e-government initiatives. They found that perceived ease of use, compatibility, and trustworthiness predict citizens' intention to use an e-government service. Similarly, Yao and Murphy (2007) drew from the literatures on technology adoption and systems design to identify factors that influence citizens' intention to use electronic voting systems, which, in turn, determines citizens' decision to vote or not. They found that ease of use, mobility, privacy, and accuracy were predictors of citizens' intention to use the systems. In another set of studies, researchers examined the factors that led to citizens' satisfaction with e-government services. For instance, Welch et al. (2005) found that government website use is positively associated with e-government satisfaction, which is, in turn, positively associated with trust in government. Similarly, based on the IS success model, Teo et al. (2008) examined the role of trust in e-government success. They found that trust significantly influences continuance intention and satisfaction, with the effects mediated via information, system, and service quality. However, in these previous studies, citizens' adoption and use of e-government services is often voluntary. For instance, instead of using the Internet, citizens may obtain government information via traditional media, such as newspapers and television, or file their taxes using paper-based filing.

Yet, there are other e-government services that have become mandatory. One example of a mandated e-government technology is the use of smart card technology in personal identity cards.

These smart cards can be required for citizens to prove their identity and to access e-government services (Bailey and Caidi, 2005; Ng-Kruelle et al., 2006; Smith, 2005). Prior research on smart card technology has emphasized security and privacy issues (e.g., Bailey and Caidi, 2005) and employed various technology adoption models (see Venkatesh et al., 2003), such as TAM and IDT, to study the adoption of smart card technology in voluntary use contexts (e.g., Aubert and Hamel, 2001; Plouffe et al., 2001; Truman et al., 2003). However, there is little empirical research investigating the mandatory adoption of smart card technology among citizens in an e-government context.

In sum, an important contribution of these previous studies is the identification of a number of antecedents of citizens' adoption of and satisfaction with e-government services. Our literature review identifies a number of antecedents that are relevant to the four stages of launching technology products, such as accessibility (Beynon-Davies, 2005), awareness (Jaeger, 2003), self-efficacy (Wang, 2003), transparency (Welch et al., 2005), accuracy (Cullen and Houghton, 2000; Yao and Murphy, 2007), security (Wang, 2003), convenience (Gilbert et al., 2004), and trust (Carter and Bélanger, 2005; Gilbert et al., 2004; Teo et al., 2008; Warkentin et al., 2002). However, as many of these antecedents were previously examined in the voluntary use context, their applicability to the mandatory use context is unclear and requires further research. Given that carrying one's identity card is a legal obligation, the context of citizens' adoption of smart cards forms a natural environment for an investigation of technology adoption in a mandatory setting.

3. Model Development

The literature on technology adoption, marketing new technology products, and e-government provides the theoretical basis for studying mandatory adoption of e-government technology. First, based on prior research on technology adoption in mandated use contexts (Brown et al., 2002; Brown et al., 2008), citizens' satisfaction, instead of their intention to use, is the relevant dependent variable in this study, as the adoption and use of smart cards is mandatory. Also, citizens' satisfaction has been suggested to be an appropriate measure of the success of e-government systems (Teo et al., 2008). In addition, we incorporate the core technology beliefs from UTAUT in our theoretical development of the mandatory adoption model because UTAUT is a comprehensive synthesis of prior technology adoption research. Thus, building on the technology beliefs in UTAUT is an appropriate first step to develop our model.

Second, prior research on marketing technology products has provided a basis for identifying and classifying antecedent variables that are relevant to different stages of launching smart cards to the public. Given that the ultimate users of the mandated e-government technology are all members of the general public, the launch strategy is particularly important in preparing citizens for the new technology, for example, by helping those socio-economically disadvantaged citizens to overcome usage barriers in terms of technical expertise and supporting resources (Hsieh et al., 2008; Ke and Wei, 2004). Also, the launch strategy helps target early adopters so as to stimulate the establishment of a critical mass of users and contribute to the wide acceptance and use of e-government (Rivera and Rogers, 2004). Further, the findings from previous research on e-government (e.g., Carter and Bélanger, 2005; Gilbert et al., 2004) shed light on some salient beliefs worthy of consideration to augment prior models of technology adoption so as to provide a more comprehensive depiction of essential beliefs driving citizens' satisfaction with e-government technology. Taken together, the investigation of relevant antecedents under different launch stages can help provide governments with insights into the design of strategic plans to improve citizens' satisfaction with mandatory e-government technology.

Based on Easingwood and Koustelos' (2000) framework for launching technology products, we have identified several factors from prior research on e-government and categorized them under different launch stages. These factors are relevant to the key strategy in each of the launch stages—i.e., providing pre-launch information in the market preparation stage, targeting existing users and innovative adopters in the targeting stage, emphasizing technological superiority in the positioning stage, and reducing the risk of adoption in the execution stage (Easingwood and Koustelos, 2000). The factors are as follows: (1) *market preparation stage*—awareness; (2) *targeting*

stage—compatibility and self-efficacy; (3) *positioning stage*—flexibility and avoidance of personal interaction; and (4) *execution stage*—trust, convenience and assistance. In developing our model, we leverage prior research to identify an initial set of factors that, as we note later, can be elaborated in future research. Our research model is shown in Figure 1.

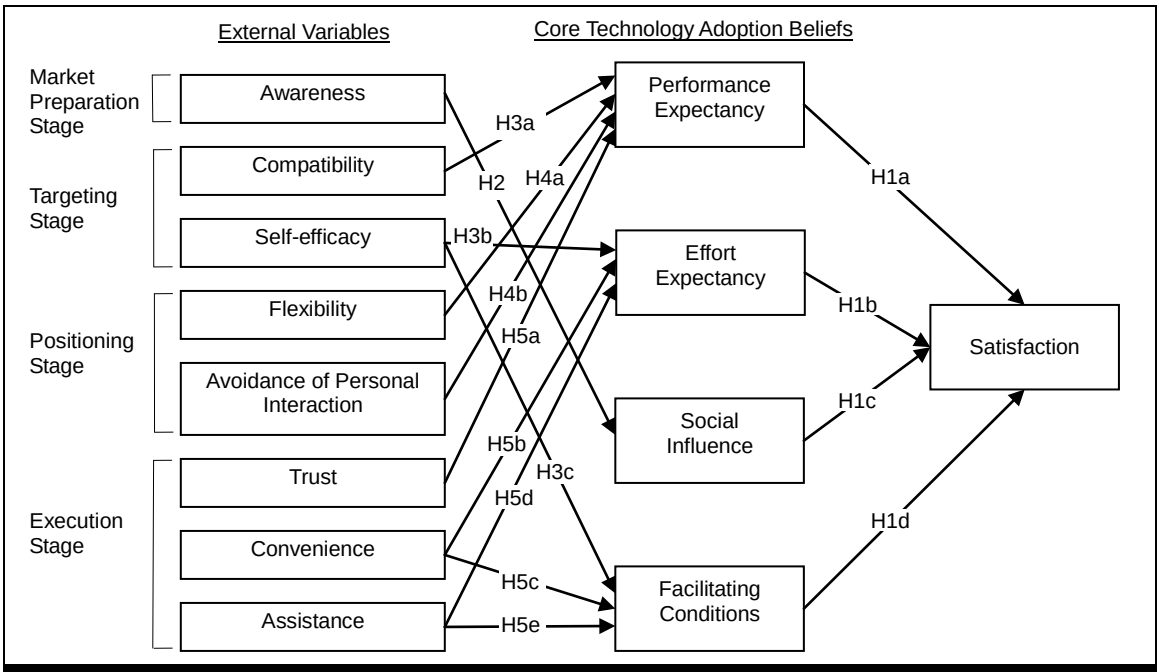

Figure 1. Research Model

In the following sections, we first discuss the core technology adoption beliefs that impact the consequences of mandatory adoption of e-government technology. Then, we describe how the external factors can influence the core technology adoption beliefs and ultimately citizens' satisfaction.

3.1 Core Technology Adoption Beliefs

As noted earlier, Venkatesh et al. (2003) identified four core technology adoption beliefs: performance expectancy, effort expectancy, social influence, and facilitating conditions. Previous studies have demonstrated the generalizability of these constructs to the adoption of different technologies in both voluntary and mandatory settings (e.g., Carlsson et al., 2006; Chen et al., 2007; Venkatesh et al., 2003; Venkatesh and Zhang, 2010; Wang et al., 2006). In the case of e-government, we expect these four key constructs to be important general determinants of citizens' satisfaction. We further expect that they can be better understood by modeling their specific antecedents. While the four key constructs represent different general perceptions about technology use, the specific antecedents may predict more than one key construct. In particular, given the similar effects of effort expectancy and facilitating conditions on intention (Venkatesh, 2000; Venkatesh et al., 2003), we suggest that certain antecedents may have cross-over effects on these two constructs. In view of these considerations, we draw on prior literature on technology adoption and e-government to determine the aspects to which the antecedents are related and provide an adequate theoretical grounding for the proposed relationships between the antecedents and the four key constructs.

In the mandatory context, the four core technology adoption beliefs—i.e., performance expectancy, effort expectancy, social influence, and facilitating conditions—are considered to be important, and each represents a key aspect of user evaluation of the technology use that contributes to user satisfaction. First, performance expectancy and effort expectancy are the two most common technological attributes that contribute to positive user attitudes and user satisfaction in work and consumer contexts (e.g., Brown et al., 2008; Hong et al., 2002; Thong, 1999; Thong et al., 2006;

Venkatesh et al., 2003), including mandated use situations (Brown et al., 2002). When the use of the technology is mandatory, performance expectancy and effort expectancy serve to encourage positive attitudes toward and user satisfaction with system use by enhancing efficiency and minimizing effort in using the technology, respectively.

Second, social influence represents the interpersonal considerations of technology use. While social influence is not expected to have a direct effect on attitude or satisfaction in prior technology adoption research, some researchers suggest that individuals may gain satisfaction by conformity based on identification (French and Raven, 2001). Based on Kelman's (1958) work on internalization and identification, Venkatesh and Davis (2000) suggested that the effect of subjective norm on intention may be mediated via attitude, although this proposition was not tested in their study. There is also evidence that normative beliefs may influence attitude (Ryan, 1982; Schepers and Wetzels, 2007). Given that user satisfaction is considered to be an attitude (Brown et al., 2002), we expect social influence to have a positive impact on user satisfaction. This relationship is expected to hold in a mandatory context, as the effect of social influence is found to be stronger in mandatory use settings due to individuals' tendency to comply with pressure from a higher authority (Venkatesh et al., 2003).

Finally, facilitating conditions represent user evaluations of the usage environment. While facilitating conditions are often theorized to have a direct effect on intention and use of IS (Taylor and Todd, 1995; Venkatesh et al., 2003), dissonance theory (Festinger, 1957) suggests that in situations where the facilitating conditions act as an inhibitor, individuals may adjust their attitudes negatively to be consistent with the situation. In contrast, given adequate resources, individuals may be more likely to form positive attitudes, as there are fewer reasons not to engage in the behavior. Thus, similar to the case of social influence, we expect facilitating conditions to have a positive influence on user satisfaction. The influence of facilitating conditions is expected to be significant in mandatory use settings, as users will vary in terms of the extent to which they have access to and ability to use facilitating resources, such as help-desk support and peer support (Hsieh et al., 2008; Sykes et al., 2009). In sum, we expect the four core technology adoption beliefs to be important in mandatory settings. We posit that these core beliefs will encourage positive attitudes toward the technology, thus having a positive influence on user satisfaction. Therefore, we hypothesize:

H1a: Performance expectancy will positively influence satisfaction with mandatory e-government technology.

H1b: Effort expectancy will positively influence satisfaction with mandatory e-government technology.

H1c: Social influence will positively influence satisfaction with mandatory e-government technology.

H1d: Facilitating conditions will positively influence satisfaction with mandatory e-government technology.

3.2 Market Preparation Stage

Market preparation is intended to get the market ready for the new technology (Easingwood and Koustelos, 2000). One particular way to prepare the market for the launch of a new technology is to provide pre-launch information via the media to create public awareness and interest (Sia et al., 2001). In consumer contexts, the information to be released has to be planned carefully so as to generate sufficient interest in the new technology without losing a competitive edge in a market where imitation can materialize with lightning speed (Easingwood and Koustelos, 2000). However, in the case of e-government, no competitor is present in the market, as the government is the sole provider of e-government technologies, such as smart cards, and their associated services. Thus, increasing citizens' awareness and interests in an e-government technology is the central concern of governments in the market preparation stage.

3.2.1 Awareness

Awareness refers to the extent to which citizens are aware of the introduction of an e-government technology (Charbaji and Mikdashi, 2003). Prior research has suggested that users' awareness is crucial for developing their attitudes toward using IT innovations in general (Sia et al., 2001) and e-

government technologies in particular (Charbaji and Mikdashi, 2003; Jaeger, 2003). Jaeger (2003) indicated that governments may be overly ambitious with e-government, investing sizable amounts yet not sufficiently making citizens aware of available e-government services. For example, in the early days of e-government, the United Kingdom spent billions of pounds to put public services online. Yet, most citizens were unaware of the services available or were reluctant to use them (Jaeger, 2003). Such a trend is common even today (Carter and Weerakkody, 2008).

Governments make public service announcements (PSAs), such as advertising broadcasts on radio or television, to increase citizens' awareness about issues of public interest, such as health, safety, and environmental protection (e.g., Cialdini, 2003). PSAs have been found to effectively increase public awareness, promote social norms, and change normative beliefs among message receivers (Borzekowski and Poussaint, 1999; Monahan, 1995). The more effective the PSAs are in creating citizens' awareness about public issues, the greater is the normative pressure being created in society. When the adoption of an e-government technology is mandatory, governments will need to devote more resources to create greater citizens' awareness and social norms in order to promote citizens' use of the mandated technology (Brown et al., 2002). In the case of smart cards, citizens' awareness about their introduction will increase with effective PSAs via different media. Citizens will be more aware of the possible uses for smart cards and the opinions of others about smart cards. Consequently, increased awareness, based on information from various media, of the mandated technology in society could make some citizens perceive that important others believe they should use the smart card (Brown et al., 2005; Venkatesh and Brown, 2001). Thus, we hypothesize:

H2: Awareness will positively influence social influence for using mandatory e-government technology.

3.3 Targeting Stage

Adoption of a new technology is likely to be faster if the marketing strategy is compatible with the segment targeted (Easingwood and Koustelos, 2000). In consumer contexts, two particular target groups are current customers and innovative adopters. Targeting existing customers is a strategy that is particularly appropriate for advanced technologies, as the decision to adopt often relies on a high degree of technical expertise (Easingwood and Koustelos, 2000). However, innovative adopters are those who have the ability to explore a product's potential for themselves and are ready to adopt the technology without trying it elsewhere (Brown and Venkatesh, 2005). In the case of smart card adoption, citizens who already use smart card technology in other contexts, such as e-commerce, are likely to possess the required expertise and find the use of smart cards for government services compatible with their lifestyles. Also, citizens with high self-efficacy are better able to explore the functionalities of smart cards by themselves and are more likely to be early adopters of the technology (Compeau and Higgins, 1995). To enhance adoption, governments should target citizens who find the e-government technology compatible with their lifestyles and who have high self-efficacy. Specifically, compatibility and self-efficacy are two factors that are relevant to the targeting stage of launching e-government technology.

3.3.1 Compatibility

Compatibility is the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters (Moore and Benbasat, 1991, p. 195). Compatibility can be assessed from different perspectives (Karahanna et al., 2006). In the context of government services, examining compatibility on the basis of individual citizens' lifestyles is essential. After all, government services are designed to make everyday life easier and better. Hence, we assess compatibility of an e-government technology in terms of the extent to which citizens believe that the technology is compatible with their lifestyles. A review of the extant IS literature suggests compatibility is an important belief that positively influences perceived usefulness of the technology (e.g., Chau and Hu, 2002; Wu and Wang, 2005). The significance of compatibility in e-government has been noted by Carter and Bélanger (2005), who included compatibility in their investigation of citizens' acceptance of electronic tax filing. If an e-government technology is highly compatible with an individual's lifestyle, he or she can use it with minimal changes and, from a cost-benefit perspective, perceive greater performance improvement. In contrast, it is unlikely that one will perceive the various

advantages of using the technology if its use is incompatible with one's lifestyle (Moore and Benbasat, 1991). Also, perceptions of performance of an innovation are a function of the fit between the innovation and one's existing practices and preferred lifestyle (Karahanna et al., 2006). When the adoption of an e-government technology is mandatory, the fit between the technology and one's existing practices is especially important because adoption of the technology means that citizens must follow preset procedures to use the technology to access needed government services. For example, in order to perform self-service immigration clearance with smart cards effectively, citizens need to find the use of smart cards to be compatible with their existing ways to use smart cards for other purposes (e.g., inserting a smart card into a card reader to retrieve payment records). Thus, we hypothesize:

H3a: Perceived compatibility will positively influence performance expectancy toward mandatory e-government technology.

3.3.2 Self-efficacy

Self-efficacy refers to a judgment of one's capability to use a technology (Compeau and Higgins, 1995). Prior studies have consistently shown the importance of self-efficacy in the computing domain. For example, self-efficacy has been found to affect computer use and early adoption of a computer system (Agarwal et al., 2000). Also, it has been suggested that self-efficacy will reinforce users' beliefs about their ability to use a technology, which is a key driver of intention to use when the use is mandated (Brown et al., 2002). In e-government settings, self-efficacy has also been found to positively affect citizens' adoption of e-government technologies, such as electronic tax filing and electronic tendering systems (Chu et al., 2004; Wang, 2003). The influence of self-efficacy can be understood from two perspectives. First, from the effort requirements perspective, citizens who are relatively high in self-efficacy are more likely to perceive that less effort is required to use a new technology than those citizens with lower self-efficacy (Venkatesh and Davis, 1996; Venkatesh, 2000). Second, from a facilitating conditions perspective, citizens who have higher self-efficacy are more likely to possess the knowledge and baseline skills to use e-government technologies. With more facilitating resources (i.e., knowledge and skills), they will perceive having greater control over using a new technology. In sum, self-efficacy is expected to influence effort expectancy and facilitating conditions, as these two general beliefs capture one's expectations about effort requirements and possession of resources that facilitate technology use, respectively. We expect self-efficacy to be especially important in mandatory settings, as citizens do not have equal capability to use the technology (Hsieh et al., 2008). Governments will thus need to target citizens who have high self-efficacy to encourage them to be early adopters, as they have relatively lower barriers to technology use in terms of required effort and access to resources. Therefore, we hypothesize:

H3b: Self-efficacy will positively influence effort expectancy toward mandatory e-government technology.

H3c: Self-efficacy will positively influence facilitating conditions for using mandatory e-government technology.

3.4 Positioning Stage

A way to position a new technology is to focus on its technological superiority and exclusivity (Easingwood and Koustelos, 2000). To position e-government technology as a replacement for traditional means of accessing government services, governments should emphasize specific characteristics that are unique to the technology and their usage contexts (Orlikowski and Iacono, 2001). For example, smart cards enable citizens to use a variety of services across different contexts (e.g., online authentication for government services and borrowing books at public libraries) and enjoy exclusive self-service functions (e.g., self-service automatic immigration clearance). Online applications such as these enable citizens to freely choose the services they want to access, allowing them to conduct business on their own time and bypass interactions with government representatives. Based on our review of the literature and the characteristics of smart cards, we identified two factors that are relevant to the positioning of smart cards—i.e., flexibility and avoidance of personal interaction. These two factors have been suggested to be important characteristics of e-government technologies (e.g., Ho, 2002) and self-service applications (e.g., Meuter et al., 2000).

3.4.1 Flexibility

Congruent with the conceptualization in prior work (e.g., Wixom and Todd, 2005), flexibility is the extent to which an e-government technology is able to adapt to the changing demands of citizens. Flexibility allows people to do more with a technology in response to new services, conditions, or needs. Flexibility is a key consideration for technology adoption and dissemination (Chengalur-Smith and Duchessi, 1999; Lefebvre et al., 1996). For instance, the prevalence of object-oriented technology is, in part, attributed to its flexibility for supporting seamless integration among various object classes and emerging object-oriented programming languages (Sultan and Chan, 2000).

Prior e-government research has identified flexibility as crucial to electronic delivery of public services (Ho, 2002). The advancements in information and communication technology allow governments to customize their services and delivery in accordance with individual citizens' preferences or needs (Ho, 2002). A highly flexible e-government technology can better meet the changing demands of citizens through adapted usage, expanded functionality, and customized presentation and delivery, which, in turn, are likely to enhance perceived performance. Such a capability is especially important in a mandatory use context, as it gives citizens a certain amount of freedom that enables them to extend the functionality of the mandated technology. For instance, smart card technology allows citizens to use their smart cards for other purposes in addition to proof of identity as a driving license or a library card. Such flexibility enables citizens to customize the functionality of their smart cards. This, in turn, makes the use of public services more efficient, as citizens are able to access multiple public services using a single card. Thus, we hypothesize:

H4a: Flexibility will positively influence performance expectancy toward mandatory e-government technology.

3.4.2 Avoidance of Personal Interaction

Avoidance of personal interaction refers to the extent to which an e-government technology allows citizens to access and use government services without having to interact with any officers. In a nutshell, governments are in the information business. Most government services are information intensive. E-government technology supports self-service—i.e., a process by which services are initiated and executed by citizens themselves without having to interact with public officials (Globerson and Maggard, 1991), such as filing income tax or making appointments with a government agency online. In general, people prefer self-service over face-to-face service because of the time savings (Bateson, 1985; Meuter et al., 2000) and increased personal control (Bateson, 1985; Dabholkar, 1996; Meuter et al., 2000). These benefits are crucial to service effectiveness and efficiency, and have important implications for performance (e.g., Meuter et al., 2000). Such self-service opportunities can substantially alleviate the tedious and often inefficient face-to-face interactions between individual citizens and relevant government officers, which represent a common source of dissatisfaction and frustration (Meuter et al., 2000). By mandating the use of such technologies that, in fact, limit the need for citizens to personally interact with government agencies or representatives—typically viewed as unpleasant interactions (Gilbert et al., 2004)—there will be a favorable view of the usefulness (performance expectancy) of the technology. Thus, we hypothesize:

H4b: Avoidance of personal interaction will positively influence performance expectancy toward mandatory e-government technology.

3.5 Execution Stage

In consumer contexts, execution is the final stage that aims to trigger a positive purchase decision (Easingwood and Koustelos, 2000). Easingwood and Koustelos (2000) noted that the strategies used in this stage depend on the objectives of the launch that, in turn, depend on the state of the technology and the awareness the market has of the technology. In the context of smart card adoption, the main objective is to encourage citizens to access e-government services using smart cards via electronic channels rather than traditional offline channels. Thus, it is important to alleviate citizens' concerns about the use of electronic channels. Prior research on services suggests that characteristics associated with the service-delivery channel are drivers of the use of self-service technologies (Meuter et al., 2005; Venkatesh, 2006). Specifically, the self-service nature of e-

government has encouraged greater use of government services through increased availability and convenience on the one hand, and raised citizens' concerns about security and privacy on the other hand (Yu, 2005). Further, the use of a technology is subject to an individual's perception regarding the availability of supporting resources (Venkatesh et al., 2003). Taken together, we identified three factors that are relevant to the execution stage of launching smart cards—i.e., trust, convenience, and assistance—that have been found to be important in the IS and services literature (e.g., Meuter et al., 2000; Pavlou and Fygenson, 2006).

3.5.1 Trust

Trust refers to the belief that the trustee will act cooperatively to fulfill the trustor's expectations without exploiting its vulnerabilities (Pavlou and Fygenson, 2006). Trust is multi-faceted, embracing several fundamental aspects that include competence, benevolence, and integrity (e.g., Gefen et al., 2003; Mayer et al., 1995). Trust is critical in social exchange relationships (Blau, 1964) and represents a common strategy for mitigating the uncertainty in unfamiliar settings. As Bradach and Eccles (1989) noted, trust is commonly used to reduce uncertainty or vulnerability in exchanges, particularly when people have limited knowledge or prior experiences. Particularly relevant to this study, trust has been found to reduce public opposition to mandatory government policies (Taylor-Clark et al., 2005).

Trust becomes increasingly important in web-based environments where the trustee and the trustor are not in each other's physical presence. As a result, privacy and security can be at great risk. When using e-commerce websites, consumers may need to provide an online vendor with payment information or sensitive personal data—e.g., credit card number, phone number, and address. The rapid increase in online fraud (Cards International, 2007) and highly publicized unauthorized access/use involving unintended exposure of personal and sensitive information has made trust increasingly critical in various contexts, such as e-commerce (e.g., Gefen et al., 2003; Pavlou and Fygenson, 2006), e-government (e.g., Carter and Bélanger, 2005; Moon and Norris, 2005; Teo et al., 2008), collaboration systems (e.g., Sia et al., 2002; Sia et al., 2004), and supply chain management systems (e.g., Patnayakuni et al., 2006). In the e-government context, citizens are more likely to expect to gain the benefits of using an e-government technology when they are confident that the technology will act in accordance with their expectations (Pavlou, 2003; Wang and Benbasat, 2005). In contrast, if an e-government technology cannot be trusted to act in a manner it promises, citizens will not expect to fully realize the utility of the technology. We expect trust to be especially important in mandatory settings. If citizens are forced to use a technology that they do not trust, it is likely to result in negative perceptions, i.e., lower performance expectancy in this case. Thus, we hypothesize:

H5a: Trust will positively influence performance expectancy toward mandatory e-government technology.

3.5.2 Convenience

Consistent with Berry et al. (2002), we define convenience as a citizen's perception of the time and effort required to use an e-government technology. Prior research has reported that convenience is a key consideration in consumers' decisions on whether to purchase through an online channel versus conventional store outlets (Torkzadeh and Dhillon, 2002). As Meuter et al. (2000) noted, people value convenient access to services when and where they want in a time-efficient manner. Similarly, in the public context, convenience is an important consideration in citizens' decisions regarding whether to participate in a government-initiated program (Everett and Peirce, 1993).

E-government promotes self-service through conveniently accessible technologies that connect citizens and government agencies on a 24/7 basis, with almost no geographical constraints (Gilbert et al., 2004). The government provides support and resources to enhance the convenience of using e-government technology, for example, by operating 24-hour workstations and on-the-road wireless Internet connections to improve availability and accessibility. As a result, less effort is required by citizens to use government services because there are fewer constraints on service time, location, and availability. Further, in a mandatory context, convenience will be particularly important. Given the potential resentment citizens may have toward using a government mandated technology, its

convenience will be salient. If a mandatory technology is inconvenient to use, then citizens will be all the more unhappy and perceive the level of effort required to be rather high. In contrast, the perceived effort required to use a more convenient mandatory technology will be minimal (Berry et al., 2002). As in the case of the convenience to effort expectancy relationship, having convenient access to support or, better yet, having a convenient technology that minimizes the need for support will contribute positively to perceptions of facilitating conditions. Again, this is likely to be the case with government mandated technologies because of the potential resentment and consequent negative views of facilitating conditions that could ensue if the technology is inconvenient to use. Thus, we hypothesize:

H5b: Convenience will positively influence effort expectancy toward the mandatory e-government technology.

H5c: Convenience will positively influence facilitating conditions for using the mandatory e-government technology.

3.5.3 Assistance

Assistance in using an e-government technology refers to a citizen's perception that help can be easily obtained when he or she encounters difficulties in using the technology. Prior work on services has highlighted the importance of customer service support in service delivery on the Internet (e.g., Barua et al., 2001; Diese et al., 2000; Parasuraman and Zinkhan, 2002). Real-time, on-demand help from a well-structured, easy-to-follow knowledge base or experienced service representative is particularly useful in electronic service operations (e.g., Barua et al., 2001; Diese et al., 2000).

Thompson et al. (1991) suggested that the provision of computer support is an important facilitating condition for an individual's adoption and use of a new technology. People usually depend on online assistance when they have problems using a system, are confused about the interface, or need to find specific information (Spool and Scanlon, 1996). Previous research has shown that such assistance is necessary not only to users with average computer skills (Kiesler et al., 2000), but also to those who are technologically savvy and have advanced computer skills (e.g., Orlikowski, 1996; Rai and Patnayakuni, 1996). According to the cumulated findings from prior service and IS research, assistance is an important component for facilitating citizens' use of an e-government technology because assistance makes the technology easier to use. Assistance is especially important when the use of an e-government technology is mandatory, as users are more likely to have diverse technical backgrounds (Hsieh et al., 2008). Thus, we hypothesize:

H5d: Assistance will positively influence effort expectancy toward mandatory e-government technology.

H5e: Assistance will positively influence facilitating conditions for using mandatory e-government technology.

4. Method

4.1 Participants and Procedure

The sampling frame was citizens replacing their old identity cards with smart cards (SmartIDs) in Hong Kong. As part of the e-government plan for Hong Kong, the government introduced SmartIDs that can be used for personal identification and access to public services. SmartID supports a variety of applications and enables citizens to access government services more effectively and efficiently. Examples of SmartID-supported e-government services include automated immigration clearance and authentication for online services, such as change of residential address, application for renewal of driving license, voter registration and tax filing. All Hong Kong citizens are required to replace their old identity cards with a SmartID. As the SmartID is a mandated e-government technology, the replacement exercise forms a natural setting for an investigation of mandatory technology adoption.

We conducted a two-stage survey. During the first stage, the survey was advertised on a government portal that allowed citizens to book appointments for replacing their identity cards. After citizens booked their appointments, they were invited to participate in an online survey. The survey asked respondents for their perceptions prior to using the technology. We measured: (1) the antecedents of

the core technology adoption beliefs—i.e., awareness, compatibility, self-efficacy, flexibility, avoidance of personal interaction, trust, convenience, and assistance; and (2) the core technology adoption beliefs—i.e., performance expectancy, effort expectancy, social influence, and facilitating conditions. Four months after the respondents collected their SmartIDs, we sent those who had responded to the first-stage survey an email invitation to participate in the second stage of the survey, where we solicited their satisfaction with the SmartID. Participants were entered into a prize drawing as an incentive for participation in the survey. There were 10 winners in the drawing, and prizes included popular consumer products such as PDAs and MP3 players.

There were 4,847 respondents to the first stage survey and 1,179 to the second stage survey. Data analysis was based on the 1,179 respondents who participated in both stages of the survey. Of these respondents, 590 (50 percent) were men and 589 (50 percent) were women. The average age of the respondents was about 28 years, with the standard deviation being about four. Respondents had, on average, about seven years of Internet experience, with a standard deviation just under three.
The age distribution of the participants was perhaps not surprising, as younger people are more likely to be more computer-literate and, thus, more likely to book appointments online.

4.2 Measurement

Appendix A provides the list of scales and their original sources. Whenever possible, we used previously validated scales and adapted them to the context of smart cards. Overall, the seven-point scales asked respondents to rate their expectations about the functionality of smart cards and about using smart cards to access government services. In particular, we modified some previously validated scales to better fit the current research context, and we developed other scales based on previous studies. First, as the use of smart cards is not limited to the work context, we modified the scale for compatibility to measure the extent to which using a system will be compatible with one's life, instead of one's work (Brown and Venkatesh, 2005). Similarly, we modified the scale for social influence to measure the extent to which one's behavior is subject to the normative influence from peers in one's social circle, instead of peers in the work setting (Venkatesh et al., 2003). Finally, we measured avoidance of personal interaction and convenience with three items each that we developed based on the definition by Gilbert et al. (2004) and the description in Meuter et al. (2000).

In addition to the focal constructs, we measured demographic characteristics, such as gender and age. As residents in Hong Kong are mainly Chinese, the measurement items were translated from English into Chinese by a professional translator. The Chinese items were then translated back into English by another professional translator to confirm the equivalence in meaning (Brislin, 1970). No significant differences in meaning were identified during the translation processes.

5. Results

We tested our model using Partial Least Squares and used a software called Smart-PLS 2.0 (Ringle et al. 2005).

5.1 Convergent and Discriminant Validity

We assessed the convergent and discriminant validity of the scales. We used two tests to evaluate convergent validity. The composite reliabilities of all constructs exceeded 0.80, and average variance extracted (AVE) for each construct was greater than 0.50 (see Table 1). The results of these two tests provided evidence for convergent validity (Fornell and Larcker, 1981). In order to evaluate discriminant validity, we examined both the factor analysis results and a comparison of AVEs with the inter-construct correlations. An exploratory factor analysis (see Appendix B) found that all items loaded significantly (0.70 or higher) on their predefined constructs, with low cross-loadings (<0.40). We also compared the square root of each construct's AVE to its correlations with other variables. The construct correlations were all below the square root of AVE for that construct (see Table 1). Both tests supported discriminant validity (Fornell and Larcker, 1981). In sum, these analyses provided evidence of convergent and discriminant validity.

Table 1: Descriptive Statistics and Correlations

	Mean	SD	AVE	CR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Gender	0.50	0.50	—	—	—														
2. Age	28.07	4.38	—	—	-.12**	—													
3. Awareness	4.92	1.04	0.75	0.90	-.05	-.04	.87												
4. Compatibility	4.87	1.14	0.87	0.95	-.09**	-.05	.59**	.93											
5. Self-efficacy	5.90	2.19	0.64	0.84	-.05	-.04	.47**	.39**	.80										
6. Flexibility	4.88	1.09	0.85	0.95	-.05	-.05	.72**	.62**	.39**	.92									
7. Avoidance of personal interaction	4.74	1.11	0.78	0.92	-.04	-.03	.46**	.59**	.30**	.41**	.88								
8. Trust	5.30	1.06	0.80	0.92	-.12**	-.02	.55**	.61**	.37**	.54**	.46**	.89							
9. Convenience	5.16	1.15	0.79	0.92	-.03	-.01	.57**	.72**	.37**	.54**	.64**	.57**	.89						
10. Assistance	4.64	1.08	0.81	0.93	-.08*	-.03	.70**	.56**	.49**	.66**	.46**	.50**	.54**	.90					
11. Performance expectancy	5.41	1.10	0.90	0.96	.03	-.05	.56**	.67**	.37**	.56**	.53**	.70**	.67**	.51**	.95				
12. Effort expectancy	5.27	1.13	0.87	0.95	-.07	-.03	.58**	.65**	.41**	.56**	.52**	.65**	.64**	.57**	.77**	.93			
13. Social influence	4.58	1.10	0.86	0.95	-.10*	.00	.43**	.57**	.27**	.46**	.48**	.53**	.49**	.43**	.53**	.52**	.93		
14. Facilitating conditions	5.11	1.07	0.73	0.89	-.09*	.02	.58**	.62**	.40**	.57**	.50**	.66**	.61**	.62**	.70**	.79**	.58**	.85	
15. Satisfaction	5.30	0.86	0.87	0.95	-.00	-.03	.42**	.46**	.28**	.43**	.34**	.44**	.45**	.38**	.50**	.49**	.33**	.48**	.93

Notes: Values on diagonal are square root of AVE. CR=Composite reliability. Gender is coded as Male=0 and Female=1.*p<.05; **p<.01.

5.2 Structural Model Testing

We included gender and age as control variables. The results are presented in Figure 2 and Table 2. Among the four core technology adoption beliefs, performance expectancy, effort expectancy, and facilitating conditions were significant determinants of satisfaction (R^2 = 30%), thus supporting H1a, H1b, and H1d. Performance expectancy was the strongest determinant of satisfaction followed by facilitating conditions and effort expectancy. Contrary to H1c, social influence was not significant in predicting satisfaction. This suggests that satisfaction may be determined by beliefs that are related to one's own usage experience—i.e., the gain in performance, the requirement in effort, and the availability of facilitating resources—rather than others' opinions. Another possible explanation is that the social normative pressure for using smart cards had not sufficiently developed, given that the deployment of smart cards was still at an early stage when we collected the data. This may account for the relatively low mean rating in social influence (see Table 1).

Among the antecedents, compatibility, flexibility, avoidance of personal interaction, and trust were significant determinants of performance expectancy (R^2 = 61 percent), thus supporting H3a, H4a, H4b, and H5a. Self-efficacy, convenience and assistance were significant determinants of effort expectancy (R^2 = 49 percent) and facilitating conditions (R^2 = 49 percent), thus supporting H3b, H3c, H5b, H5c, H5d, and H5e. Awareness was a significant determinant of social influence (R^2 = 19 percent), thus supporting H2. In sum, all external variables were significant determinants of the core technology adoption beliefs, thus supporting H2 through H5e.

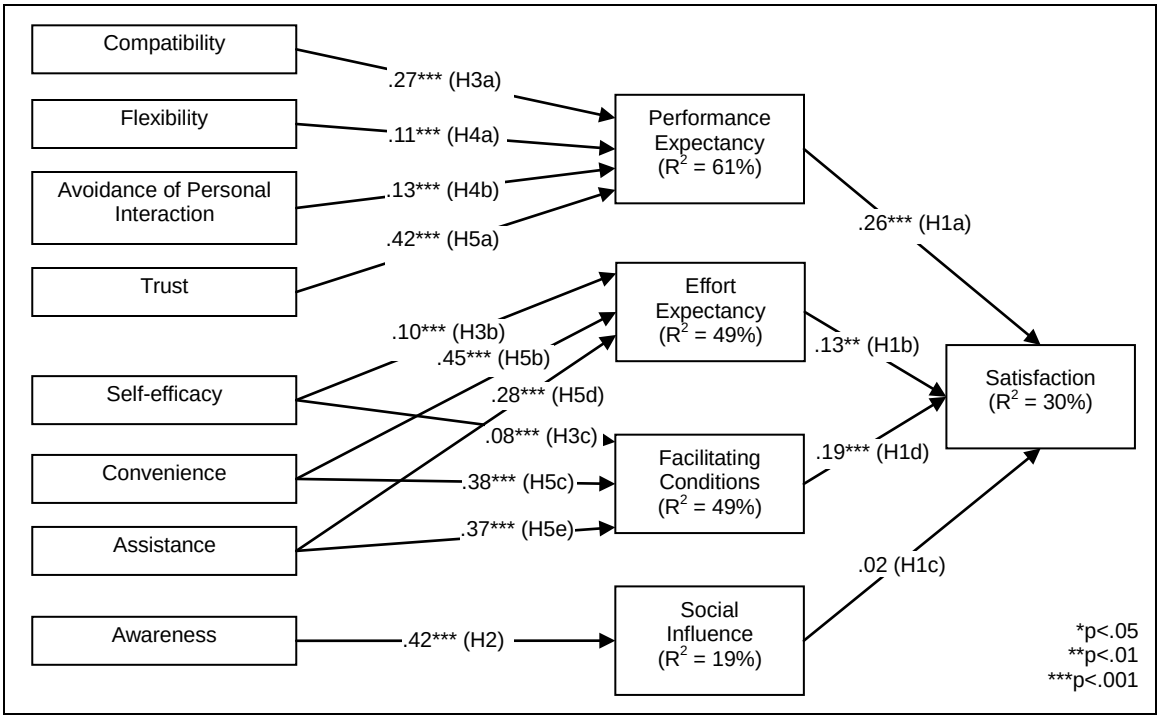

Figure 2. Model Testing Results

Because we measured all the constructs with perceptual questions in a survey, common method bias is a potential threat to the validity of our results (Podsakoff et al., 2003). Thus, to validate our results, we employed the marker variable technique (Lindell and Whitney, 2001; Malhotra et al., 2006) to account for common method bias and then tested the hypotheses based on the corrected correlations. Specifically, we chose the smallest positive correlation among the constructs measured in the same time period (i.e., 0.27) as a conservative estimate of common method variance (CMV) to produce the CMV-adjusted correlation matrix (Lindell and Whitney, 2001). Following Malhotra et al. (2006), we used the CMV-adjusted correlation matrix to estimate CMV-adjusted path coefficients and explained variance. The results show that after controlling for CMV effects, all of the path coefficients that were

originally significant remained significant, except for the path from self-efficacy to facilitating conditions. These results demonstrate the robustness and the validity of our findings.

Table 2. Results of Model Testing	
(a) Dependent Variable: Performance Expectancy	
R^2	*61%*
Compatibility	.27***
Flexibility	.11***
Avoidance of Personal Interaction	.13***
Trust	.42***
Gender	.06**
Age	-.02
(b) Dependent Variable: Effort Expectancy	
R^2	*49%*
Self-Efficacy	.10***
Convenience	.45***
Assistance	.28***
Gender	-.03
Age	-.02
(c) Dependent Variable: Social Influence	
R^2	*19%*
Awareness	.42***
Gender	-.07**
Age	.01
(d) Dependent Variable: Facilitating Conditions	
R^2	*49%*
Self-Efficacy	.08***
Convenience	.38***
Assistance	.37***
Gender	-.04
Age	.03
(e) Dependent Variable: Satisfaction	
R^2	*30%*
Performance Expectancy	.26***
Effort Expectancy	.13**
Social Influence	.02
Facilitating Conditions	.19***
Gender	.04
Age	-.02

Notes: *p<.05; **p<.01; ***p<.001.

Overall, the results support the importance of the various theorized factors in affecting the formation of core technology adoption beliefs. Our results show that trust is the strongest determinant of performance expectancy, and convenience is the strongest determinant of effort expectancy and facilitating conditions. The importance of our proposed determinants is further justified by the results that certain determinants, such as convenience and assistance, have cross-over effects on both effort expectancy and facilitating conditions. Finally, our results provide support for the effects of users' pre-use expectations on their post-use satisfaction in the mandatory adoption context.

6. Discussion

This study investigates citizens' mandatory adoption of smart cards, an e-government technology. Drawing upon prior research from information systems, e-government, and marketing, we proposed and empirically examined a rich set of external factors that may influence citizens' satisfaction with smart cards mediated by the core technology adoption beliefs from UTAUT. In general, the results provide support for our model. Further, we found evidence of the persistent influence of three of the core technology adoption beliefs on citizens' satisfaction with e-government technology. Similar to the voluntary adoption context where performance expectancy, effort expectancy and facilitating conditions are expected to have positive effects on users' intention and/or use of technology, these three key beliefs—i.e., performance expectancy, effort expectancy, and facilitating conditions—have direct effects on citizens' satisfaction in a mandatory adoption context. However, the fourth technology adoption belief, i.e., social influence, has no significant effect on citizens' satisfaction in this mandatory adoption setting.

6.1 Theoretical Implications

This work contributes to research on technology adoption, increases our understanding of e-government adoption in particular, and highlights the role of context. In this section, we discuss the theoretical implications of our findings.

This work extends our understanding of mandatory technology adoption in two key ways. First, we build on UTAUT (Venkatesh et al., 2003) and use its four core technology beliefs to predict user satisfaction, a dependent variable that is deemed more appropriate than behavioral intention for the mandatory context (Brown et al., 2002). Our results show that performance expectancy, effort expectancy, and facilitating conditions have direct effects on user satisfaction. Our findings are largely consistent with Venkatesh et al.'s (2003) findings in the context of voluntary use, with both performance expectancy and effort expectancy being significant direct determinants and with social influence being non-significant. The only difference is that facilitating conditions has a significant effect on user satisfaction in our study, while it did not have a direct effect on usage behavior in Venkatesh et al. (2003). This suggests that users' concerns may vary between the voluntary and mandatory contexts. In particular, the importance of facilitating conditions in the mandatory context is demonstrated by its significant direct effect on user satisfaction. However, one must be careful in interpreting the differences between findings in the voluntary and mandatory contexts, as the two contexts have different dependent variables. Further, although social influence does not have a significant direct effect on user satisfaction, one should not under value the importance of social influence, as it was found to have a significant interaction effect with gender and age in mandatory settings (Venkatesh et al., 2003). Recent studies (e.g., Sia et al., 2009) also suggest that peer influence may affect users' perceptions about a technology under certain circumstances. Thus, future research should further examine the role of social influence in the mandatory context by probing its possible interactions with user characteristics such as gender, age, and cultural values.

Second, our work demonstrates the value of considering technology launch stages when designing research to study mandatory technology adoption and use. Prior research has recognized the importance of identifying antecedents of core beliefs in general technology adoption models (Venkatesh and Bala, 2008; Venkatesh et al., 2007). In this regard, the four-stage framework of technology launch (Easingwood and Koustelos, 2000) provides a systematic approach for identifying factors relevant to different launch stages. As the framework of technology launch is concerned with how organizations can successfully market a new technology to potential users, it provides insights into how organizations should design strategies to improve user acceptance and satisfaction in a mandatory context, where organizations actively push new technologies to their employees. Specifically, based on the framework of technology launch, we identified a list of external factors that are related to mandatory e-government services. The results show that our factors—most of which had been modeled in prior research as determinants of intention in voluntary contexts rather than in mandatory contexts (e.g., Carter and Bélanger, 2005; Teo et al., 2008; Yao and Murphy, 2007)—significantly influence the core technology beliefs in UTAUT that, in turn, determine citizens' satisfaction. Thus, the framework of technology launch provided a useful theoretical basis to identify

external factors applicable to the mandatory context in determining core technology beliefs. However, we do not rule out the possibility that the framework of technology launch can be used to identity external factors in other technology use contexts. Future work can apply this framework to study user adoption and satisfaction of other technologies in voluntary or mandatory settings.

While the technology launch framework was useful for our purpose, it is only one approach for identifying external factors to augment technology adoption models and thereby explaining *why* people adopt and/or are satisfied with technology. Other theoretical approaches could be valuable for identifying additional external factors. In selecting such theories, it is important to consider the context. For example, if the object of research is communication media use, then theories, such as social presence (Short et al., 1976), channel expansion (Carlson and Zmud, 1999), or media synchronicity (Dennis et al., 2008), would be appropriate sources of candidate external variables.

This work also lays the foundation for extended longitudinal studies of e-government adoption. While our study incorporated two time periods, four months apart, it is likely that additional time is needed to truly uncover all of the relevant factors associated with societal adoption of a technology. By examining the four stages of technology launch, we have built a time element into our model. Depending on the stage of the introduction, we may see slightly different results. For example, the lack of significance of social influence could be a function of it being irrelevant at the stage in which we collected the data. It is possible that later in the process, when there is sufficient social pressure, it may become significant. Likewise, some factors, such as effort expectancy, may become irrelevant in satisfaction assessment in later periods.

Finally, by investigating user satisfaction in the context of e-government, we respond to the call in IS research to consider the context when theorizing about and investigating use of technology-enabled artifacts (see Orlikowski and Iacono, 2001). Our results demonstrate that considering the context can be particularly important for identifying relevant variables (see Alvesson and Karreman, 2007; Johns, 2006). Our proposed factors capture important elements that are relevant to different launch stages of e-government technology: market preparation stage (awareness), targeting stage (compatibility and self-efficacy), positioning stage (flexibility and avoidance of personal interaction) and execution stage (trust, convenience and assistance). These factors (except awareness) were found to have significant effects on citizens' satisfaction with e-government technology through the core technology adoption beliefs. Thus, this work underscores the need to consider the context in IS research.

6.2 Limitations and Future Research

This study has a few limitations that need to be considered when interpreting the results and generalizing them to other technologies and other countries. First, our findings may be subject to self-selection bias, as citizens with Internet access are more likely to respond to a web-based survey. While Hong Kong has a 90 percent Internet penetration rate, the participants in this study are relatively young and have significant experience in using Internet technologies, suggesting young technology-savvy citizens are more interested in responding to web-based surveys. Given that the initial adopters of new technologies tend to be technology-savvy, it may actually be advantageous to study these participants. Our findings can provide important insights into the design and launch of e-government services and also serve as a gauge for how the phenomenon may unfold in less technologically-sophisticated countries. Nevertheless, an important future research direction is to study the adoption of the smart card technology in the context of e-government in other populations using different sampling frames. Second, we do not claim to have included an exhaustive list of external factors in our model. There may be other equally important factors that we have omitted. Future research can build on our model and expand on the list of external factors. Third, the inclusion of a large number of external factors in our work makes an in-depth examination of each external factor unfeasible. For example, following the majority of IS research (e.g., McKnight et al., 2002; Pavlou and Fygenson, 2006), we conceptualized trust as a combination of competence, benevolence, and integrity, and examined it at a general level. Future research can examine the dimensions of the external factors and their roles in mandatory technology adoption. Finally, we have built our mandatory adoption model around the main UTAUT constructs with citizen satisfaction as the

dependent variable. While our results support the use of UTAUT constructs as part of the theoretical framework, there may be other satisfaction models that can be applied to study citizen satisfaction in a mandatory adoption context. Future research can investigate the utility of other satisfaction models, such as expectation-confirmation theory (Brown et al., 2008) in a mandatory use context.

6.3 Practical Implications

Our work could serve as a guide to governments in deploying e-government technologies in general and smart cards in particular. A major component of our model is the four stages for launching new technology products. For each stage of technology launch, we have identified the salient external factors. Specifically, in the market preparation stage, increasing citizens' awareness about the launch of an e-government technology (e.g., smart identity cards) leads to the potential for increased normative pressures. The more people know about the technology, the greater the potential impact of important others' opinions about the technology, which may, in turn, promote its use in the mandated context (Brown et al., 2002). In the targeting stage, governments should target citizens who find the e-government technology to be compatible with their life styles (e.g., existing users of smart card technologies for other purposes) and who are more technologically sophisticated. In the positioning stage, governments should position the e-government technology as a flexible device for accessing a variety of e-government services (e.g., using a smart card to borrow books at public libraries) and as a device facilitating self-services (e.g., self-service automatic immigration clearance). In the execution stage, governments should alleviate citizens' concerns about security and privacy, provide conveniently accessible technologies, and increase the availability of supporting resources for less technologically sophisticated citizens. In sum, our work suggests that governments should pay attention to the relevant external factors that are salient in the different stages of technology launch when designing launch strategies for mandatory e-government services.

There are more specific practical implications that can be drawn from the detailed links in our model. First, trust was found to be the strongest determinant of performance expectancy. This finding supports prior research that trust is critical in the context of IS where user privacy and security are at risk, such as e-commerce (e.g., online stores) and e-government (e.g., online tax filing) systems. Citizens who have higher levels of trust in using smart cards are more likely to find smart cards useful. In order to increase the trust of citizens, governments can deploy more advanced security measures, such as digital rights management and public key infrastructure, to protect personal information stored on the smart cards (Kim et al., 2006). Also, to alleviate citizens' privacy concerns, governments can improve the transparency of e-government services by informing citizens of how their personal information stored on the smart cards will be used (Welch et al., 2005).

Second, compatibility is another strong determinant of performance expectancy. This finding supports prior work that compatibility will positively affect perceived usefulness (e.g., Chau and Hu, 2002; Wu and Wang, 2005). In order to increase the compatibility of smart cards, governments can adopt the design of smart card technologies currently used in the e-commerce context. For example, the user interface of the e-government systems (e.g., menu design, screen layout, and interaction methods) should be similar to that of the e-commerce context. As a result, the use of smart cards will be similar to that of other existing smart cards for electronic transactions, and citizens will be able to use the smart cards for e-government services with less difficulty.

Third, convenience, self-efficacy, and assistance were found to influence both effort expectancy and facilitating conditions. In particular, convenience is a strong determinant of both effort expectancy and facilitating conditions. This finding supports prior research that convenience is important to consumers' channel selection (Torkzadeh and Dhillon, 2002) and valuation of self services (Meuter et al., 2000). In order to increase the convenience of using smart cards, government can provide support infrastructure, such as 24-hour workstations and on-the-road wireless Internet connection, to improve the availability and accessibility of e-government. For instance, in the mid-1990s, the Singapore government launched a nationwide broadband infrastructure to support the development of e-government (Ke and Wei, 2004). By providing support infrastructure, governments can bridge the digital divide within the population and remove constraints to citizens' use of e-government services.

Fourth, assistance was found to have a strong effect on both effort expectancy and facilitating conditions. The importance of assistance has been noted in the service and the IS literature (Barua et al., 2001; Diese et al., 2000; Thompson et al., 1991). Our results suggest that citizens find the use of smart cards easier if more assistance is provided and regard assistance as an important resource that facilitates the use of smart cards. Given that citizens cannot obtain face-to-face assistance when they use e-government services under most circumstances, careful design and effective delivery of online assistance are essential. Governments should provide assistance in various forms, such as user instructions in plain text, interactive service demos, and an enquiry hotline, to help overcome the complexity of e-government services. For services where face-to-face assistance can be made available (e.g., self-service immigration clearance using smart cards), government officers could be present on site to provide assistance to citizens who encounter difficulty in using the technology.

Finally, this study has used the core technology adoption beliefs from UTAUT as the basic framework to study citizens' satisfaction with smart cards. The results suggest that performance expectancy is the strongest determinant of satisfaction, followed by facilitating conditions and effort expectancy. This finding is consistent with prior research in technology adoption that performance expectancy is an important belief that influences technology acceptance across a wide range of technologies and user populations (e.g., Davis et al., 1989; Venkatesh et al., 2003). Thus, when promoting smart cards, governments should emphasize the superior performance and efficiency of smart card services over traditional offline services. Further, although the facilitating conditions construct was suggested to be captured within effort expectancy (Venkatesh et al., 2003), we found the effect of facilitating conditions on satisfaction to be stronger than that of effort expectancy in this study. This suggests that citizens may perceive facilitating conditions as a concept distinct from effort expectancy. Citizens may desire easy-to-use e-government services as well as resources that support their use of these services. One possible reason why facilitating conditions have a strong effect on satisfaction in the e-government context is that citizens may not have equal access to e-government services due to a possible digital divide or digital inequality (Hsieh et al., 2008). The digital divide has been identified as a major barrier to effective deployment of e-government. For instance, the United Nations (2005) has promoted "e-inclusion" to prevent the risks of access-divide widening to ensure that disadvantaged people are not left behind and to avoid new forms of exclusion due to income, educational, gender, language, and content barriers. Therefore, facilitating conditions are likely to pose a barrier to citizens' use of e-government. Citizens will be unable to use the services when they do not possess the supporting resources. Provision of these supporting resources, such as public workstations for accessing smart card-based services, will thus enhance citizens' satisfaction with e-government.

7. Conclusions

The objective of this study was to develop and test a model of mandatory technology adoption for the specific context of an e-government technology, i.e., a smart card for citizen identification and access to e-government services. We leveraged a four-stage model of new technology launch strategies to assist us in identifying eight external factors (i.e., awareness, assistance, convenience, self-efficacy, trust, avoidance of personal interaction, flexibility, and compatibility) that were expected to be particularly relevant for the context of the study. The results demonstrated the importance of these factors in influencing three core technology adoption beliefs in UTAUT, namely, performance expectancy, facilitating conditions, and effort expectancy, which, in turn, influenced citizens' satisfaction with the smart cards. Overall, the findings of this work significantly enhance our understanding of citizens' mandatory technology adoption and serve to further highlight the important role of context in our theorizing.

Acknowledgment

The authors would like to thank the Senior Editor, Bernard Tan, and the anonymous review panel for their many helpful suggestions. This project was partially funded by a grant from the Research Grants Council of Hong Kong (HKUST6266/04H and SBI09/10.BM03) and the Research Center for Electronic Commerce at the Hong Kong University of Science and Technology.

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Appendix A. Measurement Items

Awareness (Charbaji and Mikdashi, 2003)
AWA1: Hong Kong is actively embracing e-government using ***SmartID***-supported government services
AWA2: The Hong Kong Government is providing ***SmartID***-supported government services to better our lives.
AWA3: I am aware that ***SmartID***-supported government services are provided by the Hong Kong Government.

Compatibility (Moore and Benbasat, 1991)
COM1: Using ***SmartID*** to access government services would be compatible with all aspects of my life.
COM2: I think that using ***SmartID*** to access government services would fit well with the way I like to live.
COM3: Using ***SmartID*** to access government services would fit into my life style.

Self-efficacy (Compeau and Higgins, 1995)
I could use ***SmartID*** to access government services ...
SE1: ... if I could call someone for help if I got stuck.
SE2: ... if I had just the self-help information for assistance.
SE3: ... if someone showed me how to do it first.

Flexibility (Wixom and Todd, 2005)
FLE1: I expect that ***SmartID*** could be adapted to meet a variety of needs.
FLE2: I expect ***SmartID*** to be able to flexibly adjust to new demands or conditions.
FLE3: I expect ***SmartID*** to be versatile in addressing needs as they arise.

Avoidance of personal interaction (Gilbert et al., 2004; Meuter et al., 2000)
API1: Using ***SmartID*** would enable me to access government services without having to interact with anyone.
API2: Using ***SmartID***, I would not have to interact with civil servants to access government services.
API3: Using ***SmartID***, I would be able to access government services solely by myself.

Trust (McKnight et al., 2002)
TRU1: ***SmartID*** would provide government services in my best interest.
TRU2: ***SmartID*** would provide access to sincere and genuine government services.
TRU3: ***SmartID*** would perform its role of providing government services very well.

Convenience (Gilbert et al., 2004; Meuter et al., 2000)
CON1: ***SmartID*** would enable me to access government services anytime, day or night.
CON2: ***SmartID*** would enable me to access government services from home, from the office, on the road, or at other locales.
CON3: It would be convenient for me to access government services using ***SmartID***.

Assistance (Goodhue, 1998; Karimi et al., 2004)
ASS1: I expect to get the help I need in using ***SmartID*** to access government services.
ASS2: It would be easy for me to get assistance when I am having trouble using ***SmartID*** to access government services.
ASS3: I expect clear instructions for using ***SmartID*** to access government services to be available to me.

Performance expectancy (Davis et al., 1989)
PE1: Using ***SmartID*** would enable me to access government services more quickly.
PE2: Using ***SmartID*** would make it easier to access government services.
PE3: Using ***SmartID*** would enhance my effectiveness in accessing government services.

Effort expectancy (Venkatesh et al., 2003)
EE1: I would find it easy to use ***SmartID*** to access government services.
EE2: Learning to use ***SmartID*** to access government services would be easy for me.
EE3: It would be easy for me to become skillful at using ***SmartID*** to access government services.

Social influence (Davis et al., 1989)
SI1: People who influence my behavior would think that I should use ***SmartID*** to access government services.
SI2: People who are important to me would think that I should use ***SmartID*** to access government services.
SI3: People who are in my social circle would think that I should use ***SmartID*** to access government services.

Facilitating conditions (Venkatesh et al., 2003)
FC1: I expect to have the resources necessary to use ***SmartID*** to access government services.
FC2: I expect to have the knowledge necessary to use ***SmartID*** to access government services.
FC3: I expect that a specific person (or group) would be available for assistance with difficulties using ***SmartID*** to access government services.

Satisfaction (Brown et al., 2008; Davis, 1993)
All things considered, my continuing to use ***SmartID*** for government services is ...
SAT1: Extremely Negative to Extremely Positive.
SAT2: Extremely Bad to Extremely Good.
SAT3: Extremely Harmful to Extremely Beneficial.

Appendix B. Exploratory Factor Analysis

	Factor												
Item	1	2	3	4	5	6	7	8	9	10	11	12	13
EE1	0.72	0.18	0.19	0.17	0.14	0.16	0.17	0.18	0.32	0.14	0.16	0.08	0.05
EE2	0.76	0.16	0.11	0.15	0.18	0.14	0.16	0.15	0.25	0.13	0.16	0.09	0.07
EE3	0.77	0.17	0.16	0.15	0.16	0.14	0.17	0.16	0.18	0.10	0.12	0.10	0.09
SAT1	0.18	0.86	0.06	0.13	0.08	0.08	0.10	0.11	0.11	0.10	0.09	0.06	0.02
SAT2	0.18	0.87	0.10	0.10	0.08	0.09	0.11	0.10	0.14	0.09	0.10	0.03	0.03
SAT3	0.15	0.87	0.10	0.14	0.12	0.08	0.12	0.08	0.08	0.09	0.07	0.07	0.05
SI1	0.17	0.08	0.86	0.10	0.09	0.11	0.16	0.08	0.07	0.12	0.04	0.04	0.01
SI2	0.15	0.10	0.85	0.15	0.13	0.15	0.16	0.15	0.13	0.10	0.08	0.04	0.03
SI3	0.22	0.10	0.78	0.14	0.14	0.20	0.12	0.17	0.15	0.08	0.11	0.04	0.06
FLEX1	0.16	0.14	0.19	0.73	0.19	0.07	0.14	0.24	0.11	0.10	0.24	0.07	0.06
FLEX2	0.17	0.14	0.13	0.79	0.28	0.11	0.15	0.12	0.12	0.10	0.18	0.09	0.05
FLEX3	0.21	0.17	0.12	0.79	0.21	0.10	0.13	0.11	0.13	0.15	0.14	0.10	0.02
ASSI1	0.24	0.12	0.06	0.24	0.70	0.16	0.13	0.10	0.15	0.16	0.23	0.06	0.16
ASSI2	0.12	0.08	0.15	0.27	0.74	0.11	0.10	0.18	0.06	0.07	0.18	0.09	0.17
ASSI3	0.18	0.12	0.10	0.22	0.71	0.11	0.08	0.14	0.13	0.09	0.34	0.13	0.09
AVOID1	0.13	0.12	0.18	0.10	0.11	0.84	0.11	0.13	0.10	0.13	0.10	0.10	0.00
AVOID2	0.13	0.07	0.15	0.05	0.10	0.87	0.10	0.10	0.11	0.17	0.13	0.05	0.05
AVOID3	0.25	0.11	0.15	0.12	0.16	0.86	0.12	0.24	0.13	0.28	0.02	-0.04	0.12
TRUST1	0.30	0.15	0.16	0.10	0.10	0.13	0.73	0.12	0.21	0.09	0.18	0.08	0.06
TRUST2	0.23	0.12	0.19	0.17	0.13	0.13	0.78	0.13	0.16	0.09	0.10	0.11	0.02
TRUST3	0.23	0.18	0.20	0.18	0.14	0.10	0.80	0.16	0.20	0.17	0.08	0.07	0.04
COMP1	0.26	0.15	0.24	0.22	0.17	0.17	0.20	0.70	0.15	0.29	0.13	0.07	0.01
COMP2	0.25	0.17	0.20	0.23	0.12	0.23	0.16	0.73	0.16	0.21	0.10	0.08	0.06
COMP3	0.25	0.16	0.19	0.21	0.15	0.22	0.19	0.71	0.19	0.20	0.13	0.10	0.06
PE1	0.33	0.20	0.16	0.17	0.11	0.18	0.26	0.16	0.74	0.20	0.09	0.11	0.09
PE2	0.36	0.19	0.19	0.17	0.13	0.17	0.26	0.18	0.70	0.16	0.10	0.08	0.08
PE3	0.36	0.20	0.20	0.17	0.14	0.14	0.27	0.17	0.73	0.17	0.10	0.09	0.08
CONV1	0.18	0.11	0.13	0.15	0.13	0.31	0.13	0.16	0.13	0.75	0.08	0.08	0.06
CONV2	0.18	0.17	0.16	0.16	0.10	0.21	0.12	0.23	0.16	0.76	0.14	0.08	0.02
CONV3	0.35	0.19	0.12	0.12	0.22	0.20	0.18	0.28	0.29	0.70	0.19	0.05	0.07
AWARE1	0.20	0.13	0.06	0.20	0.23	0.18	0.12	0.11	0.07	0.12	0.74	0.19	-0.04
AWARE2	0.15	0.12	0.14	0.33	0.24	0.11	0.18	0.20	0.14	0.16	0.75	0.15	0.03
AWARE3	0.20	0.15	0.15	0.30	0.27	0.07	0.16	0.06	0.11	0.09	0.73	0.08	0.16
SE1	0.04	0.07	0.10	0.08	0.24	0.07	0.07	0.19	0.07	-0.05	0.12	0.72	0.20
SE2	0.17	0.08	0.05	0.09	0.16	0.10	0.07	0.06	0.04	0.09	0.05	0.84	0.18
SE3	0.15	0.08	0.01	0.12	0.06	0.04	0.11	-0.01	0.07	0.15	0.12	0.85	0.16
FC1	0.36	0.17	0.25	0.17	0.14	0.11	0.23	0.18	0.23	0.18	0.10	0.07	0.74
FC2	0.34	0.19	0.19	0.13	0.20	0.14	0.23	0.11	0.15	0.11	0.12	0.07	0.71
FC3	0.32	0.14	0.28	0.13	0.20	0.11	0.20	-0.04	0.12	0.12	-0.08	0.23	0.76
Eigen value	5.47	3.24	3.20	2.94	2.89	2.63	2.58	2.21	2.16	2.15	1.61	1.53	1.11
Variance explained (%)	14.04	8.32	8.20	7.53	7.42	6.73	6.60	5.68	5.54	5.52	4.14	3.92	2.84

Notes:
EE: Effort expectancy; SAT: Satisfaction; SI: Social influence; FLEX: Flexibility; ASSI: Assistance; AVOID: Avoidance of personal interaction; COMP: Compatibility; PE: Performance expectancy; CONV: Convenience; AWARE: Awareness; SE: Self-efficacy; FC: Facilitating conditions.

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