*The utilization of e-government services: citizen trust, innovation and acceptance factors**

Lemuria Carter† & France Bélanger‡

Pamplin College of Business, Virginia Polytechnic Institute & State University, 3007 Pamplin Hall, 0101, Blacksburg, VA 24061-0101, USA, †email: lecarter@vt.edu and ‡belanger@vt.edu

Abstract. *Electronic government, or e-government, increases the convenience and accessibility of government services and information to citizens. Despite the benefits of e-government – increased government accountability to citizens, greater public access to information and a more efficient, cost-effective government – the success and acceptance of e-government initiatives, such as online voting and licence renewal, are contingent upon citizens' willingness to adopt this innovation. In order to develop 'citizen-centred' e-government services that provide participants with accessible, relevant information and quality services that are more expedient than traditional 'brick and mortar' transactions, government agencies must first understand the factors that influence citizen adoption of this innovation. This study integrates constructs from the Technology Acceptance Model, Diffusions of Innovation theory and web trust models to form a parsimonious yet comprehensive model of factors that influence citizen adoption of e-government initiatives. The study was conducted by surveying a broad diversity of citizens at a community event. The findings indicate that perceived ease of use, compatibility and trustworthiness are significant predictors of citizens' intention to use an e-government service. Implications of this study for research and practice are presented.*

Keywords: e-government, adoption, citizen trust, Technology Acceptance Model, Diffusion of Innovation theory

INTRODUCTION

E-government is the use of information technology to enable and improve the efficiency with which government services are provided to citizens, employees, businesses and agencies.

*A preliminary version of this paper using pilot data only was presented at the HICSS 2004 conference, January 5–9, 2004 in Hawaii.

Federal, state and local governments have implemented various e-government initiatives to enable the purchase of goods and services, distribution of information and forms, and submission of bids and proposals (GAO, 2001). These online services are beneficial to both citizens and government. Agencies realize cost reductions and improved efficiency, while citizens receive faster, more convenient services (Trinkle, 2001).

In light of these benefits, e-government is expected to grow. There are predictions of more than $600 billion of government fees and taxes to be processed through the web by 2006 (James, 2000). US federal government spending is predicted to reach $2.33 billion by 2005 (Gartner Group, 2000). While there seems to be substantial growth in the development of e-government initiatives, it is not clear whether citizens will embrace those services. The success and acceptance of e-government initiatives, such as online voting and licence renewal, are contingent upon citizens' willingness to adopt these services. Numerous studies have analysed user adoption of e-commerce (McKnight *et al*., 2002; Gefen *et al*., 2003; Pavlou, 2003; Van Slyke *et al*., 2004). There is now a need to identify core factors influencing citizen adoption of e-government. A survey of chief administrative officers at government agencies reveals that 74.2% of government agencies have a web site, but that 90.5% have not conducted a survey to see what online services citizens and businesses actually want (ICMA, 2002).

This study integrates constructs from established e-commerce adoption models based on the Technology Acceptance Model (Gefen & Straub, 2000; Moon & Kim, 2001; Gefen *et al*., 2003; Pavlou, 2003), Diffusion of Innovation (Van Slyke *et al*., 2004) and web trust (Bélanger *et al*., 2002; McKnight *et al*., 2002; Gefen *et al*., 2003) into a parsimonious model of e-government adoption.

BACKGROUND

Various categorizations of e-government exist. Hiller & Bélanger (2001) and Bélanger & Hiller (2005) classify e-government into six categories: Government Delivering Services to Individuals (G2IS), Government to Individuals as a Part of the Political Process (G2IP), Government to Business as a Citizen (G2BC), Government to Business in the Marketplace (G2BMKT), Government to Employees (G2E) and Government to Government (G2G). G2IS involves communication and services between government and citizens, while G2IP involves the relationship that the government has with citizens as a part of the democratic process, such as e-voting. Similarly, while G2BC involves organizations paying taxes or filing reports, G2BMKT focuses on business transactions between government and businesses, such as e-procurement.

Government agencies have their own categorizations. Both the US Government's General Accounting Office (GAO) and Office of Management Budget (OMB) use government-to-citizen (G2C), government-to-business (G2B), government-to-employee (G2E) and government-to-government (G2G) categories. Examples of G2C include *Access America* (communities of users) and *Savings Bond Direct* (savings bonds sales). *FedBizOpps,* which provides access to federal government business opportunities, is a G2B example. One example of G2G is the *National Environmental Information Exchange Network* used for communications among

states, and the Environmental Protection Agency. A fourth category is called Government to Employees (G2E) by GAO and Internal Efficiency and Effectiveness by OMB. It focuses on interactions with employees. An example is *Employee Express,* where federal employees can manipulate their savings and health benefits accounts online (GAO, 2001; OMB, 2002).

Comparisons to e-commerce

Because we intend to use models tested in e-commerce contexts, we first discuss the differences between e-government and e-commerce. Jorgensen & Cable (2002) identify three major differences: access, structure and accountability. In e-commerce, businesses are allowed to choose their customers; however, in e-government, agencies are responsible for providing access to the entire eligible population, including individuals with lower incomes and disabilities. The digital divide makes this task of providing universally accessible online government services challenging. In addition, the structure of businesses is different from the structure of agencies in the public sector. Decision-making authority is less centralized in government agencies than in businesses. This dispersion of authority impedes the development and implementation of new government services. The third difference is accountability. In a democratic government, public sector agencies are constrained by the requirement to allocate resources and provide services 'in the best interest of the public' (Jorgensen & Cable, 2002). Warkentin *et al*. (2002) recognize the political nature of government agencies as a distinguishing feature of e-government from e-commerce. They also note that mandatory relationships exist only in e-government.

There are also many similarities between e-commerce and e-government, and as previous research has found that factors from Technology Acceptance, Diffusion of Innovation and trustworthiness models play a role in user acceptance of e-commerce (Gefen & Straub, 2000; Moon & Kim, 2001; Gefen *et al*., 2003; Pavlou, 2003), it is expected that they will also affect citizen adoption of e-government (Warkentin *et al*., 2002; Carter & Bélanger, 2003; 2004).

Technology Acceptance Model (TAM)

Davis' (1989) Technology Acceptance Model (TAM) is widely used to study user acceptance of technology (Figure 1). The measures presented in Davis' study target employee acceptance of

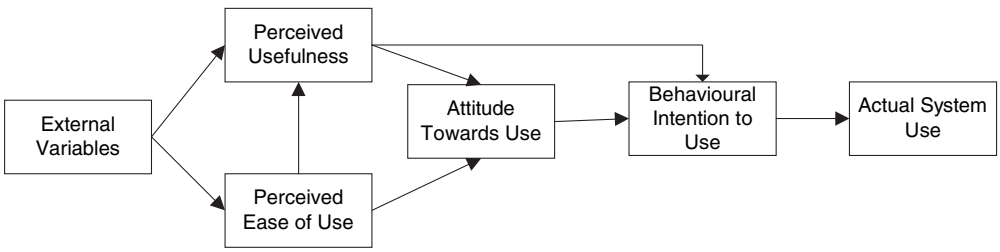

Figure 1. Technology Acceptance Model (Davis, 1989).

organizational software, but these measures have been tested and validated for various users, experienced and inexperienced, types of systems, word processing, spreadsheet, email, voice mail, etc., and gender (Chau, 1996; Jackson *et al*., 1997; Doll *et al*., 1998; Karahanna & Straub, 1999; Venkatesh & Davis, 2000; Venkatesh & Morris, 2000). Studies have also used TAM to evaluate user adoption of e-commerce (Gefen & Straub, 2000; Moon & Kim, 2001; Gefen *et al*., 2003; Pavlou, 2003).

TAM is based on the theory of reasoned action, which states that beliefs influence intentions, and intentions influence one's actions (Ajzen & Fishbein, 1972). According to TAM, perceived usefulness (PU) and perceived ease of use (PEOU) influence one's attitude towards system usage, which influences one's behavioural intention to use a system, which, in turn, determines actual system usage. After refinement, attitude towards usage was eliminated from the model.

Davis defines PU as 'the degree to which a person believes that using a particular system would enhance his or her job performance (Davis, 1989)', and PEOU as 'the degree to which a person believes that using a particular system would be free of effort (Davis, 1989)'. Perceived ease of use is predicted to influence perceived usefulness, because the easier a system is to use, the more useful it can be. These constructs reflect users' subjective assessments of a system, which may or may not be representative of objective reality. System acceptance will suffer if users do not perceive a system as useful and easy to use (Davis, 1989).

Diffusion of Innovation

Rogers' (1995) Diffusion of Innovation (DOI) theory is another popular model used in information systems research to explain user adoption of new technologies. Rogers defines diffusion as 'the process by which an innovation is communicated through certain channels over time among the members of a social society' (Rogers, 1995). An innovation is an idea or object that is perceived to be new (Rogers, 1995).

According to DOI, the rate of diffusion is affected by an innovation's relative advantage, complexity, compatibility, trialability and observability. Rogers (1995) defines relative advantage as 'the degree to which an innovation is seen as being superior to its predecessor'. Complexity, which is comparable to TAM's perceived ease of use construct, is 'the degree to which an innovation is seen by the potential adopter as being relatively difficult to use and understand'. Compatibility refers to 'the degree to which an innovation is seen to be compatible with existing values, beliefs, experiences and needs of adopters'. Trialability is the 'degree to which an idea can be experimented with on a limited basis'. Finally, observability is the 'degree to which the results of an innovation are visible' (Rogers, 1995). After an extensive literature review, Tornatzky & Klein (1982) conclude that relative advantage, compatibility and complexity are the most relevant constructs to adoption research. Thus, we include these in our study.

Moore & Benbasat (1991) present image, result demonstrability, visibility and voluntariness as additional factors influencing the acceptance and use of an innovation. They name the extended model perceived characteristics of innovating (PCI). Moore and Benbasat suggest

that image refers to one's perceptions of an innovation as a status symbol. Image is also included in Ajzen & Fishbein's (1972) theory of reasoned action, which is the foundation for TAM, as subjective norm. Subjective norm posits that individuals will be more likely to engage in some activity if others who are important to them approve of the activity. Given the amount of coverage web-based systems have received in the popular press, we include image in our study.

We do not include voluntariness and trialability. Voluntariness is the degree to which individuals feel they have the option to use an innovation or not. As citizen use of a web-based state government service is an individual choice and is not likely to be mandated, voluntariness would be unlikely to show significant variability, and is therefore inappropriate for our study. Trialability is the degree to which potential adopters feel that they can use the innovation before they actually adopt it. Again, it is doubtful that perceived trialability would display enough variance to offer explanatory power.

Trustworthiness

Perceptions of trustworthiness could also impact citizens' intention to use state e-government services. Bélanger *et al*. (2002) define trustworthiness as 'the perception of confidence in the electronic marketer's reliability and integrity'. Citizens must have confidence in both the government and the enabling technologies. According to the Hart–Teeter national survey reported by GAO (2001), Americans believe that e-government has the potential to improve the way government operates, but that they have 'concerns about sharing personal information with the government over the internet, fearing that the data will be misused and their privacy diminished' (GAO, 2001). Privacy and security are reoccurring issues in e-commerce and e-government research (Hoffman *et al*., 1999; Chadwick, 2001; GAO, 2001; Miyazaki & Fernandez, 2001; Bélanger *et al*., 2002; Bélanger & Hiller, 2005).

Extending the work of previous researchers (Rotter, 1967; 1971; 1980; Zucker, 1986; Mayer *et al*., 1995; McKnight & Cummings, 1998), McKnight *et al*. (2002) establish measures for a multidimensional model of trust in e-commerce, focusing on users' initial trust in a web vendor. Initial trust refers to 'trust in an unfamiliar trustee, a relationship in which the actors do not yet have credible, meaningful information about, or affective bonds with, each other' (McKnight *et al*., 2002). In initial relationships, 'people use whatever information they have, such as perceptions of a web site, to make trust inferences' (McKnight *et al*., 2002).

One of McKnight *et al*.'s (2002) four major constructs, institution-based trust, is associated with an individual's perceptions of the institutional environment, such as the structures, regulations and legislation that make an environment feel safe and trustworthy. This construct contains two dimensions: structural assurance and situational normality. Structural assurance means 'one believes that structures like guarantees, regulations, promises, legal recourse or other procedures are in place to promote success' (McKnight *et al*., 2002). Situational normality presumes that the environment is normal, favourable, in proper order and that vendors have the attributes: competence, benevolence and integrity (McKnight *et al*., 2002). The decision to engage in e-government transactions requires citizen trust in the state government agency pro-

viding the service and citizen trust in the technology through which electronic transactions are executed, the internet (Lee & Turban, 2001).

Comparison of the theoretical models

TAM, DOI/PCI and trust have been explored by using diverse settings and methods, and their constructs have proved to be important to adoption research. Integrating these three models provides a parsimonious yet comprehensive explanation of citizens' intention to use an e-government service. Each model can be juxtaposed by using three elements: focus, unit of analysis and disciplinary background. Focus identifies the concepts of importance to the theory, such as attitude towards technology or citizen trust in government. The primary unit of analysis refers to the entity of interest in the model, such as an individual or organization. Disciplinary background refers to the field(s) in which the model originated and/or is frequently applied. A comparison using these, presented in Table 1, reveals fundamental differences and similarities among the models.

The theoretical models, in particular TAM and DOI/PCI, have overlapping constructs. The complexity construct from DOI is similar (in reverse direction) to the perceived ease of use (PEOU) construct from TAM. In our study, we decided to use the well-tested PEOU construct to represent this concept. Similarly, some researchers have suggested that perceived usefulness and relative advantage are the same construct. For example, Venkatesh *et al*. (2003) include the two as the same construct in their united theory of acceptance and use of technology (UTAUT) model, but rename it *performance expectancy*. However, there may be conceptual distinctions between the two constructs. For example, relative advantage may refer to the use of web technologies over other means of government interactions, while perceived usefulness may refer to the actual usefulness of online government services. Because the overlap is not clear, we include both constructs in our model.

We include both DOI/PCI and TAM constructs in our e-government adoption because DOI constructs add significantly to the prediction of adoption intent (Plouffe *et al*., 2001). TAM, which is theoretically nested within the DOI model, explains 32.7% of the variance in intention to adopt in Plouffe *et al*.'s (2001) study, while the PCI model explains 45% of the variance. These two percentages are not noticeably different; however, they cannot be compared

Table 1. Theoretical comparison

	TAM	DOI/PCI	Trustworthiness
Focus	Perceptions and attitudes towards technology	Technology characteristics, market (supply–demand) adopters' characteristics	Citizens' perceptions of the trustworthiness of government and technology
Primary unit of analysis	Individual users/non-users	Organizations, individuals	Individuals
Disciplinary background	Management Information System (MIS)	Sociology, communication, policy, MIS	Political science, public administration

TAM, Technology Acceptance Model; DOI, Diffusion of Innovation; PCI, perceived characteristics of innovating.

directly. Plouffe *et al*. (2001) estimate a reduced PCI model using two constructs – relative advantage and ease of use – that are most similar to the TAM constructs. This reduced model explained 36.2% of the variance in intentions, which is significantly lower than the variance explained by the full PCI model with eight adoption constructs. They concluded that a more comprehensive set of innovation characteristics adds significantly to the prediction of adoption intent. Figure 2 illustrates the constructs and their overlap.

Research model and hypotheses

Building on the theoretical models, we present an integrated model (Figure 3), which captures individuals' perceptions of technology, adoption characteristics and trustworthiness.

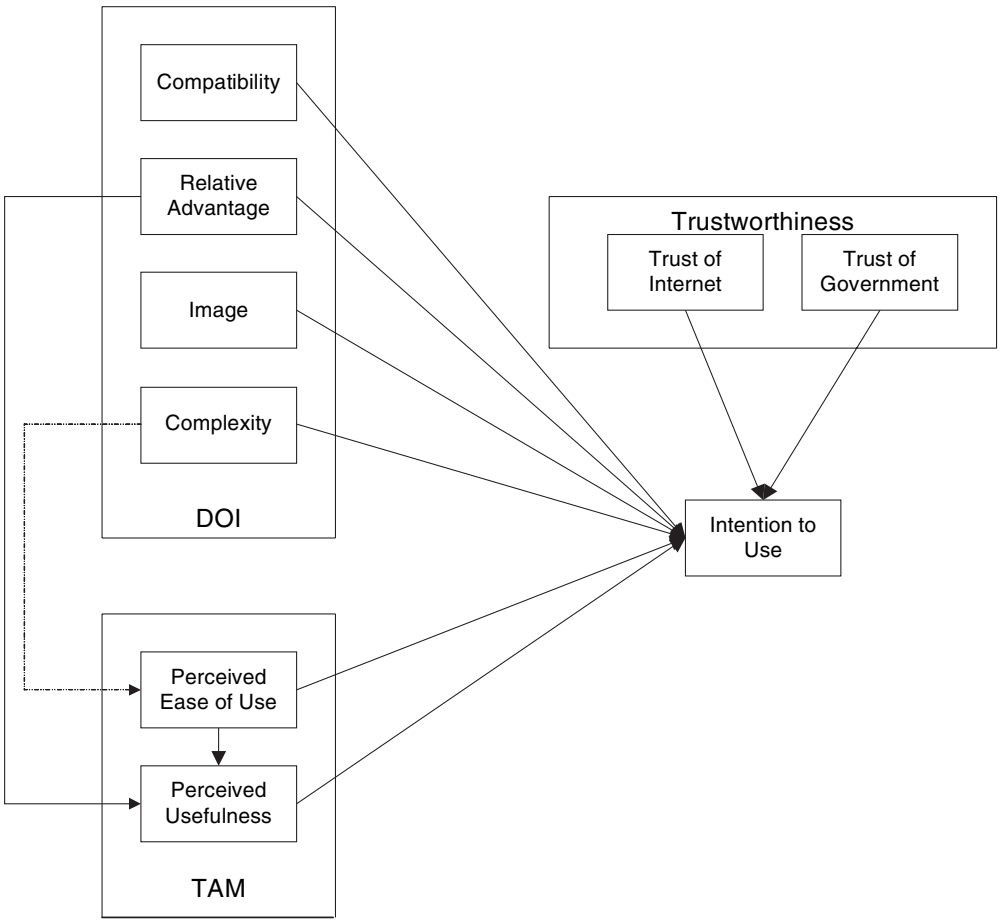

Figure 2. Adoption research.

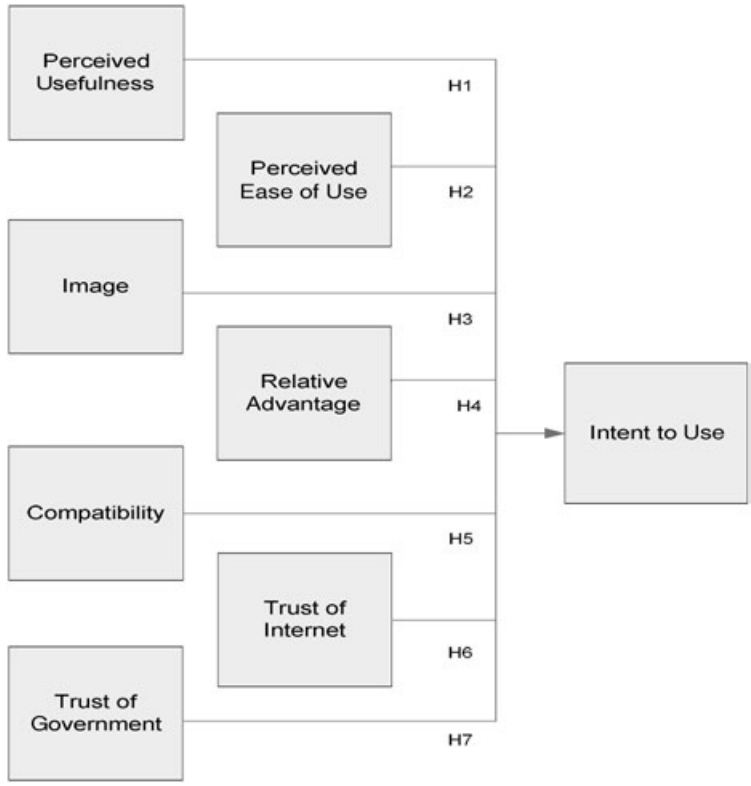

Figure 3. Research model.

The model takes into account overlaps previously discussed and integrates constructs from various fields: information systems, sociology and public administration. The model is more comprehensive than the individual theoretical models and attempts to capture the complex relationships involved in e-government. Considering the similarities between e-commerce and e-government, we expect the directional impacts of the constructs tested in prior e-commerce research to be the same in the context of e-government. The resulting hypotheses are presented in Table 2.

METHODOLOGY

To test the model in the most realistic way possible, the study was conducted through a survey of a broad diversity of citizens at a community event. Items were adapted from previous studies: trustworthiness of the internet (McKnight *et al.*, 2002); trustworthiness of state government (Pavlou, 2003; Van Slyke *et al.*, 2004); perceived ease of use and usefulness (Davis, 1989;

Table 2. Hypotheses

	Hypothesis	Construct
H1	Higher levels of perceived usefulness will be positively related to higher levels of intention to use a state e-government service	Perceived usefulness
H2	Higher levels of perceived ease of use will be positively related to higher levels of intention to use a state e-government service	Perceived ease of use
H3	Higher levels of perceived image will be positively related to higher levels of intention to use a state e-government service	Perceived image
H4	Higher levels of perceived relative advantage will be positively related to higher levels of intention to use a state e-government service	Perceived relative advantage
H5	Higher levels of perceived compatibility will be positively related to higher levels of intention to use a state e-government service	Perceived compatibility
H6	Higher levels of trust in the internet will be positively related to higher levels of intention to use a state e-government service	Perceived trustworthiness of the internet
H7	Higher levels of trust in state government agencies will be positively related to higher levels of intention to use a state e-government service	Perceived trustworthiness of state government

Gefen & Straub, 2000); PCI items (Moore & Benbasat, 1991; Van Slyke *et al*., 2004); and intentions (Gefen & Straub, 2000; Pavlou, 2003). Final survey items are in Appendix 1.

Two versions of the survey were created. To test state e-government adoption, we selected two widely known state online systems in Virginia: the Department of Motor Vehicle (DMV) and the Department of Taxation (TAX). Questions and instructions were worded according to which instrument version the respondent received. The selection of two agencies was deemed important to obtain increased generalizability of results.

The instrument was pretested for unclear wording and revised. It was then pilot tested with 136 undergraduate students. The initial reliability measures using Cronbach's alpha were above the 0.70 cut-off (Cronbach, 1970). Construct validity was evaluated by using factor analysis, and most items loaded properly on their expected factors. Slight changes in wording were done on marginal items.

Sample

In the actual study, the instrument was administered to 106 citizens at a community concert. Of the 106 administered questionnaires, 105 were completed and used in the analyses. The ages of the subjects ranged from 14 to 83 years, with males accounting for 36.39% of the sample. Fifty-six per cent of the subjects were Caucasian; 26% were minorities; and 18% did not report ethnicity. Ninety-six per cent reported having convenient access to the web, and 80% used it every day. Sixty-seven per cent of the subjects use the web to gather information several times a week, but most subjects (61%) use the web to make a purchase less than once a month. Eighty-three per cent of the subjects use the web to gather information from the government, and 66% have used the web to complete a government transaction. Some of the demographic statistics are summarized in Table 3.

Data analysis

The two versions of the instrument (DMV and TAX) were handed out randomly, and roughly half of the respondents answered one of the versions. To control for bias towards a particular state government agency with respect to respondent demographics, we ran chi-square tests. All chi-squares were non-significant, indicating that there were no statistical differences between respondent demographics for the two versions of the survey. We also ran tests for differences in use across the two agencies, which revealed no statistical significance. We then conducted reliability analyses using Cronbach's alpha, as presented in Table 4.

Construct validity was evaluated by using factor analysis. As can be seen from Table 5, most items loaded properly on their expected factors. Cross loading items PEOU4, CT4 and USE4 were dropped from further analysis. The items from trust of the internet (Trus_I) and trust of state government (Trus_S) loaded together. As both constructs, Trus_I and Trus_S, are proposed to constitute trustworthiness, we combined them into one variable – Trustworthiness (TRUST) for the regression analyses.

Relative advantage (RA) and compatibility (CT) items loaded together. These constructs have loaded together in other DOI research (Moore & Benbasat, 1991; Carter & Bélanger, 2003). Moore and Benbasat conducted a thorough study using several judges and sorting rounds to develop reliable measures of diffusion of innovation constructs (Rogers, 1995). Although the items for RA and CT were identified separately by the judges and sorters, they all loaded together. Moore and Benbasat concluded, 'this may mean that, while conceptually different, they are being viewed identically by respondents, or that there is a causal relationship

Table 3. Demographics

Demographic	Minimum	Maximum	Mean
Age	14	83	36
Years computer use	0	35	12
Years full-time work	0	50	10
Annual family income (USD)	<10 000	>300 000	25–86 000

Table 4. Reliability analysis – citizen data

Construct	No. of items	Alpha
Perceived usefulness	5	0.8827
Perceived ease of use	5	0.8638
Image	4*	0.8169
Relative advantage	5	0.8435
Compatibility	4	0.8309
Trust of internet	3	0.9202
Trust of state government	4	0.8734
Use intentions	5	0.9195

*Originally measured with five items. A reverse-worded item was dropped.

Table 5. Factor analysis – citizen data

	Factor loadings				
Item	PEOU	IM	RA & CT	TRUST	USE
PEOU1	0.894				
PEOU3	0.767				
PEOU5	0.932				
PEOU6	0.751				
IM1		0.894			
IM3		0.876			
IM5		0.900			
RA1			0.859		
RA2			0.880		
RA4			0.917		
RA5			0.766		
CT1			0.923		
CT2			0.923		
CT3			0.813		
TRUS_I1				0.815	
TRUS_I2				0.816	
TRUS_I3				0.840	
TRUS_S1				0.750	
TRUS_S2				0.892	
TRUS_S3				0.817	
TRUS_S4				0.812	
USE1					0.937
USE2					0.913
USE3					0.890
USE5					0.898
PU1			0.838		
PU2			0.906		
PU4			0.730		
PU5			0.907		

PEOU, perceived ease of use; IM, image; RA, relative advantage; CT, compatibility; TRUS_I, trust of the internet; TRUS_S, trust of state government; USE, use intentions; PU, perceived usefulness.

between the two (Moore & Benbasat, 1991)'. For example, 'it is unlikely that respondents would perceive the various advantages of using [state e-government services], if its use were in fact not compatible with the respondents' experience or [life] style (Moore & Benbasat, 1991)'.

Perceived usefulness also loaded with RA and CT. A similar argument to the one used to justify RA and CT loading together can be used to explain PU and RA loading together. Perceived usefulness refers to the belief that a new technology will help one accomplish a task, while relative advantage refers to the belief that an innovation will allow one to complete a task more easily than he or she can currently. Conceptually, these two constructs are very similar. They both refer to the use of an innovation to facilitate and ease the attainment of some goal.

As RA and PU capture essentially the same concept, we decided to drop PU from further analysis.

In summary, model and hypotheses tests were conducted with five independent variables – PEOU, image (IM), RA, CT and trustworthiness (TRUST) – and one dependent variable – use intentions (USE). The basic characteristics of these variables are presented in Table 6.

Model testing

Multiple regression analysis was used for hypothesis testing. First, a regression analysis was performed to assess the significance of demographics on use intentions. None of the demographics were significant, and were therefore not included as covariates in the final analyses. We then tested for regression assumptions. There were no violations of assumptions of multivariate normal distribution, independence of errors and equality of variance. Multicollinearity was not a concern with variance inflation factors ranging from 1.039 to 6.615 for the main effect regression model. Outlier influential observations were identified with leverage, studentized residuals and Cook's *D*-statistic. This analysis indicated that there were no problems with respect to influential outliers.

Results

The model explains 85.9% (adjusted R^2) of the variance in citizen adoption of e-government. Because the overall model is significant ($F = 120.879$, $P = 0.000$), we tested the significance of each variable. Perceived ease of use, compatibility and trustworthiness are significant. Table 7 illustrates which hypotheses are supported.

DISCUSSION

The research results are summarized in Figure 4. We discuss their implications below.

Table 6. Final regression variables

Variable	No. of items	Mean	Standard deviation
Perceived ease of use	4	5.3778	1.25539
Image	3	2.8921	1.32731
Relative advantage	4	5.1635	1.23657
Compatibility	3	5.1238	1.36619
Trustworthiness	7	4.5134	1.29096
Intent to use	4	5.1865	1.36565

Table 7. Hypothesis testing

	Variable	Coefficient	*t*-value	Significance	Support
H1*	Perceived usefulness	n/a	n/a	n/a	n/a
H2	Perceived ease of use	0.172	2.574	0.012	YES
H3	Image	−0.042	−1.080	0.283	NO
H4	Relative advantage	0.156	1.606	0.111	NO
H5	Compatibility	0.524	5.935	0.000	YES
H6 & H7†	Trustworthiness	0.155	2.877	0.005	YES

*Because perceived usefulness loaded with compatibility and relative advantage, it was dropped from further analysis.

†Because trust of the internet and trust of state government loaded together, we combined items from each construct and tested it as one construct: (trustworthiness).

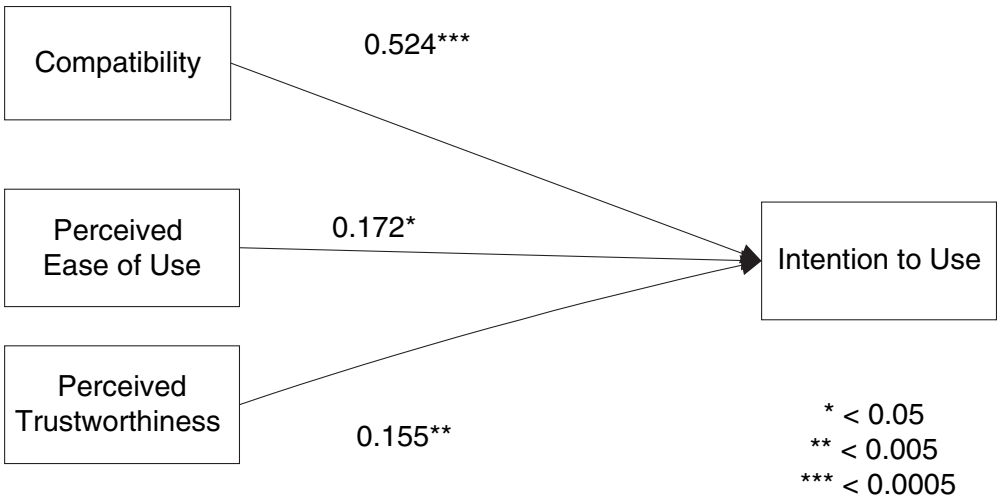

Figure 4. Results.

Perceived ease of use

Hypothesis 2 is supported. Citizens' intentions to use a state e-government service will increase if citizens perceive the service to be easy to use. In general, this indicates that it is imperative for online government services to be intuitive. A state government web site should be easy to navigate. Information should be organized and presented based on citizens' needs, allowing users to quickly and effortlessly find the information or services they seek. If a user becomes frustrated because of the inability to seamlessly locate information and complete transactions, this will decrease his or her intention to adopt e-government services.

The significance of PEOU is particularly important when considering the sample used for this study. Respondents' ages ranged from 14 to 83 years. The results of the pilot study, which

was administered to undergraduate students very familiar with the use of computers and the internet, indicated that PEOU is not significant. However, our sample included citizens with a varied level of computer and internet expertise, and our finding may reflect this fact. If this is the case, it suggests that governments have to be careful with the potential for the digital divide, to prevent certain citizens from benefiting from online services. As such, state governments should not only make their online services intuitive and easy to use, but should also develop educational material to explain the use of online services, and provide classes in community centres or through community organizations to help those not as familiar with computers and the internet to become apt at using them for access to online government services.

Compatibility

Hypothesis 5 is also supported. Higher levels of perceived compatibility are associated with increased intentions to adopt state e-government initiatives. This finding indicates that citizens will be more willing to use online state services if these services are congruent with the way they like to interact with others. For example, citizens who regularly use the web socially (emailing friends, downloading music), economically (shopping for goods/services) or professionally (procuring business items) can be expected to also adopt this innovation for government interaction.

Compatibility was the most significant of our findings. This is not surprising as compatibility has often been found to have the most significant relationship with use intentions in other contexts, including e-commerce (Van Slyke *et al*., 2004). To increase citizens' intent to use their state government services online, agencies should provide information and services in a manner that is consistent with other ways citizens have dealt with the government. For example, online forms should resemble paper forms that citizens are familiar with. Compatibility could also be achieved by agencies agreeing to standard interfaces for their web sites. Although this is unlikely to happen in the short term, a push by citizens for more government services may eventually lead to such standardization. By making interfaces and interactions with the sites similar across agencies, compatibility will be enhanced as citizens move from one site to another.

Trustworthiness

Hypotheses 6 and 7, once combined, are also supported. This suggests that higher levels of perceived trustworthiness are positively related to citizens' intentions to use a state e-government service. As explained before, trustworthiness is composed of two constructs: trust of the internet and trust of state government. Unlike the results of the pilot study, where 99% of the subjects had used the internet to gather information about a product or service, the results of this more comprehensive study with a broad diversity of subjects indicate that trust of the internet is a significant predictor of e-government adoption.

With respect to perceptions of trustworthiness of the internet, citizens who perceive the reliability and security of the internet to be low will be less likely to adopt e-government ser-

vices. A study conducted by Hart–Teeter for the Council for Excellence in Government (2003) found that in the United States, although Americans believe e-government services are beneficial, they have reservations about providing personal information to the government via the internet for fear that the data will be misused and their privacy compromised (Hart–Teeter, 2003). State government agencies must reassure citizens, through consistent and accurate service, that e-government is both safe and beneficial. In the private sector, seals such as Verisign's have been used to indicate high levels of security. Government agencies should consider the use of such security seals. Furthermore, they must indicate clearly and in plain language what steps are being taken to provide security online. This information should be posted not only online, but also in state agencies' offices or in documentation mailed to citizens.

With respect to the perceptions of trustworthiness of state government agencies, citizens who perceive the agencies to be more trustworthy will be more likely to adopt e-government services. Components of trustworthiness identified in previous work on e-commerce, such as benevolence, integrity and competence (e.g. McKnight *et al*., 2002, etc.), could be considered as starting points for state governments to act on. For example, state agencies must convey to citizens that state government employees have both the desire (benevolence) and ability (competence) to provide citizen-centred information and services designed to meet their needs. This could be accomplished by distributing documentation to citizens on the role of e-government services and including pictures of employees who provide the services. This documentation could be provided both online and offline.

Non-significant results

Unexpected results are also interesting to evaluate. Two of our hypothesized relationships did not prove to be significant. Hypothesis 3 was not supported, suggesting that higher levels of perceived image do not directly affect citizens' intentions to use state government services online. While this is consistent with previous work where image was not a good predictor of e-commerce use intentions when compared to the other DOI constructs (Van Slyke *et al*., 2004), it remains an interesting finding. In the United States, use of the internet has become so visible – from magazine ads to demonstrations of use on television – that citizens may not view its use as extraordinary. Therefore, using the internet to transact with the government is not image enhancing: it is normal.

Surprisingly, hypothesis 4 was also not supported. Higher levels of perceived relative advantage do not directly affect citizens' intentions to use state e-government services. Relative advantage refers to the perception that a new system allows one to accomplish a task more effectively or efficiently than the current system. As the majority of our sample uses the web to search for information and conduct transactions with both government and business, it is possible that these citizens do not view e-services as an innovation. Eighty per cent of them use the web everyday; 83% use the web to gather information from the government; and 66% have used the web to complete a government transaction. These citizens consider online interaction with the government to be compatible (hypothesis 3) with their lifestyle and may therefore

expect the option to interact with government via the web. As a result, they do not perceive e-government services as providing a relative advantage. After all, many citizens are accustomed to interacting with friends, family and business online; adding government to the list does not present a new benefit; it meets an existing expectation.

Another potential explanation for this finding stems from the fact that we had to choose between the relative advantage and perceived usefulness constructs, considering that they loaded together. As stated before, some researchers consider the two to be the same, while others do not. We selected relative advantage, but decided to run a post hoc analysis using perceived usefulness instead. Results were similar. Yet, this may indicate that this construct needs further development, maybe as *performance expectancy* as suggested by Venkatesh *et al*. (2003).

Research implications

This study presents an integrated, parsimonious model of e-government adoption that incorporates constructs from TAM, DOI and trustworthiness. The model explains 85.9% of the variance in citizen intention to use state e-government initiatives. It extends previous adoption research by collecting and analysing data from a diverse pool of citizens that are more representative of the population than college students are. The large ranges in age, ethnicity, computer experience and use of the web presented in this study are a major contribution to the field. Such a diverse sample provides insight into citizen, not student, perceptions of the internet's role in government services.

Interestingly, our sample of actual citizens included many individuals that have already conducted a transaction with the government online (66% of our sample). Admittedly, we chose the Department of Motor Vehicles and the Virginia Taxation web sites because they are recognized as some of the most popular state agencies online. Yet, it is surprising to know that so many citizens have actually conducted such transactions. In contrast, our student sample in the pilot test was much less likely to have conducted an online transaction with a state government (36.7%). This highlights the need to conduct e-commerce and e-government studies with actual citizens rather than student samples.

Although our study did not find relative advantage as a significant predictor of intent to use state e-government services, we believe that future research should clarify and investigate the role of relative advantage, perceived usefulness or performance expectancy in this context. Further, it would be very valuable to study the specific components of trustworthiness as they relate to online e-government services. Because perceptions of trustworthiness affect intent to use e-government services and trust models often suggest that it is a combination of trust in the internet, the merchant (or government) and the product (or service) that affects overall perceptions of trustworthiness (Lee & Turban, 2001), these components should be evaluated separately and in combination within the context of e-government. Finally, research should also be conducted on the image construct. As stated before, while using e-government services online might not be image enhancing in the United States, it may not be the case in other countries and cultures. This should be investigated further.

Implications for practice

Perceived ease of use, compatibility and trustworthiness were all significant indicators of citizens' intention to use state e-government services. There are many ways in which government agencies can increase perceived ease of use. One is through their web sites, by providing online tutorials that offer concise tips and illustrations of how to search and transact with that site. E-government sites should also enhance their search and help features to enable users to quickly and effortlessly find relevant information. Third, state governments should elicit and analyse citizen feedback about their site. This feedback will enable governments to redesign sites to present information and services in a way that is easy for citizens to utilize.

Government agencies can increase perceived compatibility by making the adoption of online services as seamless and natural as possible. Online services should resemble traditional government services to encourage citizen acceptance. For instance, if a state agency makes tax filing available online, the agency should present a form that resembles the more familiar paper-based tax forms.

Perceptions of trustworthiness may be the most difficult yet vital perceptions for government agencies to increase to facilitate the adoption of state e-government services. To increase perceptions of trustworthiness, government agencies can reassure citizens of the reliability of e-services by including easily visible privacy statements on their sites. They should also provide accurate, timely and dependable services. If citizens have a positive experience with an e-government service, they will be more likely to use the service (and others like it) again. In addition, they will probably share this positive experience with others, thereby encouraging adoption. However, a negative experience prompted by unavailability of service, erroneous information or a technical error will probably have the reverse effect, discouraging adoption by that citizen and others.

Limitations

There are limitations to this study. First, the sample size is relatively small at 105 citizens. However, being able to collect data from a diverse sample in terms of age, ethnicity and economic background increases the generalizability of the findings. Future studies should seek larger sample sizes to perform more complex model testing. We selected only two state agencies, but attempted in our selection to include two very different government services. Clearly, the answers were influenced by the nature of the online services selected. Future studies should include a broader set of agencies to validate these results.

CONCLUSION

This study integrates constructs from the Technology Acceptance Model, Diffusion of Innovation and trustworthiness models, into an insightful model of e-government adoption. The results indicate that perceived ease of use, compatibility and trustworthiness are significant

indicators of citizens' intention to use state e-government services. Knowledge of the factors that influence adoption will enable government agencies to develop online services that meet the needs of their citizens. The study also highlights the importance of conducting research with a broad diversity of respondents.

ACKNOWLEDGEMENTS

Support for this research was provided by the ACIS Department at Virginia Tech. We also want to thank the Virginia Tech Union for permission to collect data at their community events, and the associate editor and reviewers for insightful comments on an earlier draft of this paper.

REFERENCES

Ajzen, I. & Fishbein, M. (1972) Attitudes and normative beliefs as factors influencing intentions. *Journal of Personality and Social Psychology*, **21**, 1–9.

Bélanger, F. & Hiller, J. (2005) A framework for e-government: Privacy implications. *Business Process Management Journal*, **11**, (in press).

Bélanger, F., Hiller, J. & Smith, W. (2002) Trustworthiness in electronic commerce: the role of privacy, security, and site attributes. *Journal of Strategic Information Systems*, **11**, 245–270.

Carter, L. & Bélanger, F. (2003) *Diffusion of Innovation and Citizen Adoption of E-government Services.* The Proceedings of the 1st International E-Services Workshop, 57–63.

Carter, L. & Bélanger, F. (2004) *Citizen Adoption of E-government Initiatives.* The Proceedings of the 37th Hawaiian International Conference on Systems Sciences, 5–8.

Chadwick, S. (2001) Communicating trust in e-commerce interactions. *Management Communication Quarterly*, **14**, 653–658.

Chau, P. (1996) An empirical assessment of a modified technology acceptance model. *Journal of Management Information Systems*, **13**, 185–204.

Cronbach, L. (1970) *Essentials of Psychology Testing*. Harper & Row, New York, USA.

Davis, F. (1989) Perceived usefulness, perceived ease of use and user acceptance of information technology. *MIS Quarterly*, **13**, 319–340.

Doll, W., Hendrickson, A. & Deng, X. (1998) Using Davis's perceived usefulness and ease-of-use instrument for decision making: a confirmatory and multigroup invariance analysis. *Decision Sciences*, **29**, 839–869.

GAO (General Accounting Office), McClure, D. (2001) Electronic government: challenges must be addressed with effective leadership and management. 11 July 2001. [WWW document]. URL http://feapmo.gov/links.asp

Gartner Group (2000) E-government strategy: cubing the circle. Research Notes, Strategic Planning Assumption, 20 April 2000. [WWW document]. URL http://www.gl.iit.edu/gartner2/research/87900/87955/87955.html

Gefen, D., Karahanna, E. & Straub, D. (2003) Trust and TAM in online shopping: an integrated model. *MIS Quarterly*, **27**, 51–90.

Gefen, D. & Straub, D. (2000) The relative importance of perceived ease of use in IS adoption: a study of e-commerce adoption. *Journal of the Association for Information Systems*, **1**, 1–28.

Hart–Teeter (2003) The new e-government equation: ease, engagement, privacy and protection. April, 2003. [WWW document]. URL http://www.excelgov.org

Hiller, J. & Bélanger, F. (2001) Privacy strategies for electronic government. E-government series, January 2001. The Pricewaterhouse Coopers endowment for the business of government. [WWW document]. URL http://www.businessofgovernment.org/GrantDetails.asp?GID=60

Hoffman, D., Novak, T. & Peralta, M. (1999) Building consumer trust online. *Communications of the ACM*, **42**, 80–85.

ICMA Electronic Government Survey Findings (2002) [WWW document]. URL http://egov.e21corp.com/site/html/eNewsletter/oct2002/survey.html

Jackson, C., Chow, S. & Leitch, R. (1997) Toward an understanding of the behavioral intention to use an information system. *Decision Sciences*, **28**, 357–389.

James, G. (2000) Empowering bureaucrats. *MC Technology Marketing Intelligence*, **20**, 62–68.

Jorgensen, D. & Cable, S. (2002) Facing the challenges of e-government: a case study of the city of Corpus Christi, Texas. *SAM Advanced Management Journal*, **67**, 15–22.

Karahanna, E. & Straub, D. (1999) The psychological origins of perceived usefulness and perceived ease of use. *Information and Management*, **35**, 237–250.

Lee, M. & Turban, E. (2001) A trust model for internet shopping. *International Journal of Electronic Commerce*, **6**, 75–91.

McKnight, H., Choudhury, V. & Kacmar, C. (2002) Developing and validating trust measures for e-commerce: an integrative typology. *Information Systems Research*, **13**, 334–359.

McKnight, H. & Cummings, L. (1998) Initial trust formation in new organizational relationships. *Academy of Management Review*, **23**, 473–490.

Mayer, R., Davis, J. & Schoorman, D. (1995) An integrative model of organization trust. *Academy of Management Review*, **20**, 709–734.

Miyazaki, A. & Fernandez, A. (2001) Consumer perceptions of privacy and security risks for online shopping. *Journal of Consumer Affairs*, **35**, 27–44.

Moon, J. & Kim, Y. (2001) Extending the TAM for a world-wide-web context. *Information and Management*, **28**, 217–230.

Moore, G. & Benbasat, I. (1991) Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, **2**, 173–191.

OMB, Office of Management and Budget (2002) E-government strategy. 27 February 2002. [WWW document]. URL http://www.cio.gov/documents/EgovStrategy.html

Pavlou, P. (2003) Consumer acceptance of electronic commerce: integrating trust and risk with the technology acceptance model. *International Journal of Electronic Commerce*, **7**, 69–103.

Plouffe, C., Hulland, J. & Vandenbosch, M. (2001) Research report: richness versus parsimony in modeling technology adoption decisions – understanding merchant adoption of a smart card-based payment system. *Information Systems Research*, **12**, 208–222.

Rogers, E. (1995) *Diffusion of Innovations*. The Free Press, New York, USA.

Rotter, J. (1967) A new scale for the measurement of interpersonal trust. *Journal of Personality*, **35**, 651–665.

Rotter, J. (1971) Generalized expectancies for interpersonal trust. *American Psychologist*, **26**, 443–452.

Rotter, J. (1980) Interpersonal trust, trustworthiness, and gullibility. *American Psychologist*, **35**, 1–7.

Tornatzky, L. & Klein, K. (1982) Innovation characteristics and innovation adoption implementation: a meta-analysis of findings. *IEEE Transactions on Engineering Management*, **29**, 28–45.

Trinkle, S. (2001) Moving citizens from in line to online: how the internet is changing how government serves its citizens. 30 September 2001. [WWW document]. URL http://www.bcinow.com/demo/oel/Resources_Articles.htm

Van Slyke, C., Bélanger, F. & Comunale, C. (2004) Adopting business-to-consumer electronic commerce. The effects of trust and perceived innovation characteristics. *The Data Base for Advances in Information Systems*, **35**, 32–49.

Venkatesh, V. & Davis, F. (2000) A theoretical extension of the technology acceptance model: four longitudinal field studies. *Management Science*, **46**, 186–204.

Venkatesh, V. & Morris, M. (2000) Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. *MIS Quarterly*, **24**, 115–139.

Venkatesh, V., Morris, M., Davis, G. & Davis, F. (2003) User acceptance of information technology: toward a unified view. *MIS Quarterly*, **27**, 425–478.

Warkentin, M., Gefen, D., Pavlou, P. & Rose, G. (2002) Encouraging citizen adoption of e-government by building trust. *Electronic Markets*, **12**, 157–162.

Zucker, L.G. (1986) Production of trust: institutional sources of economic structure. In: *Research in Organizational Behavior*, Staw, B.M. & Cummings, L.L. (eds), **8**, 53–111. JAI Press, Greenwich, CT, USA.

Biographies

Lemuria Carter, a native of Richmond, Virginia, is currently a third year PhD candidate in the department of Accounting and Information Systems at Virginia Tech. Her research interest is in e-government adoption. She is the recipient of numerous awards and scholarships, including the KPMG doctoral scholarship sponsored by KPMG and the PhD Project and the Commonwealth fellowship award sponsored by Virginia Tech. She has published in the

Electronic Journal of E-Government. She has also presented her work at various conferences, including the Hawaiian International Conference on Systems Sciences and the International Conference of Electronic Commerce. Lemuria obtained her MS in Accounting and Information Systems from Virginia Tech and her BS in Information Systems and Decision Sciences from Virginia State University.

France Bélanger PhD, is Director of the Center for Global E-Commerce; Associate Professor and Alumni Research Fellow in the Department of Accounting and Information Systems at Virginia Tech. Her research interests focus on the use of telecommunication technologies in organizations, in particular for e-commerce and distributed work. She is widely published in IS journals, including *Information Systems Research, Communications of the ACM, IEEE Transactions on Professional Communication*, *Information & Management, Database*, *Journal of Strategic Information Systems*, *Information Resources Management Journal,* and others. She co-authored *Evaluation and Implementation of Distance Learning: Technologies, Tools and Techniques* (Idea Group Publishing, 2000), and *E-Business Technologies* (John Wiley and Sons, 2003). She is Associate Editor of the *Journal of Electronic Commerce in Organizations*. Her work has been funded by the US National Science Foundation, US Department of Education, the Boeing Company and PriceWaterhouseCoopers, among others.

APPENDIX 1: ANNOTATED ITEMS

Technology acceptance model (TAM)

Use intentions (USE)

USE1. I would use the web for gathering information from VA TAX.
USE2. I would use VA TAX services provided over the web.
USE3. Interacting with the VA TAX over the web is something that I would do.
USE4. I would not hesitate to provide information to the VA TAX website.
USE5. I would use the web to inquire about VA TAX services.

Perceived usefulness (PU)

PU1. The VA TAX web site would enable me to complete transactions with VA TAX more quickly.
PU2. I think the VA TAX web site would provide a valuable service for me.
PU3. The content of the VA TAX web site would be useless to me.
PU4. The VA TAX web site would enhance my effectiveness in searching for and using VA TAX services.
PU5. I would find the VA TAX web site useful.

Perceived ease of use (PEOU)

PEOU 1. Learning to interact with the VA TAX web site would be easy for me.
PEOU 3. I believe interacting with the VA TAX web site would be a clear and understandable process.
PEOU 4. I would find the VA TAX web site to be flexible to interact with.
PEOU 5. It would be easy for me to become skilful at using the VA TAX web site.
PEOU 6. I would find a VA TAX web site difficult to use.
**PEOU2 was not used in the actual study; it was dropped after the pilot study.*

Diffusion of Innovation (DOI)

Relative advantage (RA)

RA1. Using the web would enhance my efficiency in gathering information from the VA TAX.
RA2. Using the web would enhance my efficiency in interacting with the VA TAX.
RA3. Using the web would not make it easier to gather information from the VA TAX.
RA4. Using the web would make it easier to interact with the VA TAX.

RA5. Using the web would give me greater control over my interaction with the VA TAX.

Compatibility (CT)

CT1. I think using the web would fit well with the way that I like to gather information from the VA TAX.
CT2. I think using the web would fit well with the way that I like to interact with the VA TAX.
CT3. Using the web to interact with the VA TAX would fit into my lifestyle.
CT4. Using the web to interact with the VA TAX would be incompatible with how I like to do things.

Image (IM)

IM1. People who use the web to gather information from the VA TAX have a high profile.
IM2. People who use VA TAX services on the web have a high profile.
IM3. People who use the web to gather information from the VA TAX have more prestige than those who do not.
IM4. People who use VA TAX services on the web have less prestige than those who do not.
IM5. Interacting with the VA TAX over the web enhances a person's social status.

Trustworthiness (TRUST)

Trust of the internet (TRUS_I)

TRUS_I1. The internet has enough safeguards to make me feel comfortable using it to interact with the VA TAX online.
TRUS_I2. I feel assured that legal and technological structures adequately protect me from problems on the internet .
TRUS_I3. In general, the internet is now a robust and safe environment in which to transact with the VA TAX.

Trust of state government (TRUS_S)

TRUS_S1. I think I can trust VA TAX.
TRUS_S2. The VA TAX can be trusted to carry out online transactions faithfully.
TRUS_S3. In my opinion, VA TAX is trustworthy.
TRUS_S4. I trust VA TAX to keep my best interests in mind.