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# Trust and Electronic Government Success: An Empirical Study

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**ABSTRACT:** Electronic government is being increasingly recognized as a means for transforming public governance. Despite this increasing interest, information systems (IS) literature is mostly silent on what really contributes to the success of e-government

Web sites. To fill this gap, this study examines the role of trust in e-government success using the updated DeLone and McLean IS success model as the theoretical framework. The model is tested via a survey of 214 Singapore e-government Web site users. The results show that trust in government, but not trust in technology, is positively related to trust in e-government Web sites. Further, trust in e-government Web sites is positively related to information quality, system quality, and service quality. The quality constructs have different effects on “intention to continue” using the Web site and “satisfaction” with the Web site. Post hoc analysis indicates that the nature of usage (active versus passive users) may help us better understand the interrelationships among success variables examined in this study. This result suggests that the DeLone and McLean model can be further extended by examining the nature of IS use. In addition, it is important to consider the role of trust as well as various Web site quality attributes in understanding e-government success.

**KEY WORDS AND PHRASES:** e-government, intention to continue, IS success model, public sector, quality, trust.

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E-GOVERNMENT, WHICH CAN BE BROADLY DEFINED as the use of information and communication technologies (ICTs) and the Internet to enhance the access to and delivery of all facets of government services and operations for the benefit of citizens, businesses, employees, and other stakeholders, is continuously transforming public service delivery systems [67]. Despite worldwide enthusiasm toward e-government, e-government endeavors have mostly fallen short of their potential. This issue is even more visible in the context of developing countries, where only about 15 percent of all e-government initiatives have been successful in attaining their major goals without any significant undesirable outcomes [33]. Further, the creation of e-government Web sites alone does not guarantee their usage by citizens. The usage of Web sites in general, and e-government Web sites in particular, can be divided into two stages—“initial usage” and “continued usage.” It is observed that in most cases after “initial usage” of e-government Web sites, many users revert to traditional ways for acquiring information and services, such as telephone inquiry, personal visits, and so forth [2]. Therefore, engaging and retaining citizens in using e-government Web sites for “continued usage” is a challenge being faced by most government agencies providing online public services. Predicated by this challenge, in this study, we focus on the factors influencing *intention to continue using* the e-government Web sites rather than the *intention to use* (which relates primarily to initial usage).

On one hand, an e-government Web site is a technological innovation. This implies that the technological attributes of the Web site may affect users’ attitudes and behaviors toward the Web site. Previous research has examined this aspect in terms of the role played by Web site quality perceptions in influencing users’ adoption and consequent satisfaction with the Web site [19, 20]. Extrapolating this argument for e-government Web sites, positive or negative perceptions of users toward e-government Web site quality attributes (information quality, system quality, and service quality) may influ-

ence the users' intention for continued usage of e-government Web sites as a means for interacting with the government agencies.

On the other hand, a Web site is much more than an information technology (IT) interface. Different types of risks and uncertainties prevail in online transactions [53, 68]. Therefore, trust is a vital key for retaining Web site users through the establishment and maintenance of an interactive, multisession, online relationship [27]. Past literature has identified trust to be one of the crucial enablers of e-commerce transactions [26, 52, 54] and e-loyalty [17]. In the context of e-government, the role of trust for continued usage of Web sites is even more important as citizens using e-government Web sites are unlikely to find alternative Web sites serving the same purpose. In the absence of sufficient trust in e-government Web sites, users may be motivated to revert to the traditional offline means of interaction with the government. Therefore, building citizen trust is often considered as a key factor for the successful implementation of e-government Web sites [74].

Although some research has been done to examine Web site adoption and success, relatively little is known about the role of trust in the success of e-government Web sites, especially in the postadoption stage. To address this research gap, we examine the following research questions:

*RQ1: How are "trust in technology" and "trust in government" related to trust in e-government Web sites?*

*RQ2: How is trust in e-government Web sites related to its consequent success as defined by DeLone and McLean's framework of information systems (IS) success?*

The current study attempts to answer these two questions by integrating the literature on online trust and DeLone and McLean's [19] IS success model (henceforth referred to as the D&M model). There are three primary contributions of this research. First, this study explores the important role of online trust for e-government Web site success by facilitating their continued usage. By integrating the literature on online trust and the D&M model, this study provides a comprehensive understanding of Web site success in general and e-government Web sites in particular. To the best of our knowledge, this is the first study that attempts to integrate these two research streams for assessing Web site success. Second, in this study, we extend the multidimensional concept of IS success [18, 19] by addressing citizens' postadoption behavior of e-government Web sites. While initial acceptance of IS is an important preliminary step toward realizing IS success, user's continued use of IS will account for its eventual success [8]. Hence, in the context of e-government, citizen's continued use of e-government Web sites will account for e-government's eventual success.

Third, this research facilitates our understanding of Web site adoption and usage in the public sector. Although developing e-government Web sites has currently become a global trend, the mechanisms pertaining to the ways in which quality beliefs and trusting beliefs affect citizen's long-term adoption and usage of e-government Web sites still remains largely unclear. The current study, using both the IT as well as trust-related factors, extends our understanding of Web site adoption and usage in the e-government

context. Further, examining trust and the updated D&M model in a context different from past studies helps us gauge the consistency of the various factors affecting IS success and consequently aids in claims about empirical generalizations [5].

## Theoretical Framework and Hypotheses

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PREVIOUS RESEARCH ON E-GOVERNMENT, especially in the government-to-citizen (G2C) context, has identified factors facilitating citizen's adoption of e-government Web sites and also their consequent impact. For example, Warkentin et al. [74] suggested that citizen's intention to engage in e-government is affected by factors such as trust in e-government, perceived usefulness (PU), and perceived ease of use (PEOU). Chang et al. [13] found that citizen's adoption intention of online tax filing is affected by PU and PEOU. In turn, PU and PEOU are determined by information quality, system quality, and perceived credibility of the Web site. In another study, Cohen [16] found that citizen's satisfaction with contacting government on the Internet is affected by citizen's personal characteristics, reason to contact, level of government, and the processes and outcomes of the experience.

Similarly, previous research has also emphasized the role of trust in Web site success in terms of adoption (or behavioral intention to adopt) [27, 51], satisfaction [4], and intention to use [38] or reuse the Web site [70]. In general, online trust has been found to be related to three success variables—trust-related behavioral intention, satisfaction, and perception of Web site IT attributes. Trust is a significant antecedent of participation in online interactions and transactions because it serves as a central mechanism to reduce perception of uncertainty and risk.

Many studies on "online trust" treat behavioral intentions as the final dependent variable [27, 51]. Comparatively fewer studies have discussed the relationship between trust and satisfaction. Generally, satisfaction reflects the "affect status," which is shaped by the user's previous experience with the Web site, and trust shapes the user's expectation toward the future behavior of the trustee [39, 44]. Thus, satisfaction is sometimes regarded as an antecedent of trust. On the other hand, satisfaction has also been described as an outcome of trust. For example, Balasubramanian et al. [4] found that perceived trustworthiness of an online broker is directly related to the online investor's satisfaction. Yoon [77] also argued that satisfaction could be an outcome of online trust and suggested a positive correlation between trust and satisfaction.

Previous research on online trust also finds positive relationship between trust and user's perception of Web site attributes. Based on the theory of reasoned action (TRA) [1], a few studies have linked trust to technology acceptance model (TAM) variables—that is, PU and PEOU of a Web site [27, 51]. However, most studies on online trust have been conducted in the context of e-commerce and we still know very little about the role of online trust in the public sector delivery of e-services—namely, e-government Web sites. Our study explores this vital but relatively unaddressed aspect of online trust using the D&M model as the theoretical framework.

The D&M model is a widely cited framework in the IS literature that provides a comprehensive view of "IS success." DeLone and McLean [18] suggested that IS suc-

cess is a multidimensional concept consisting of six interrelated variables—system quality, information quality, use, user satisfaction, individual impact, and organizational impact. Later, DeLone and McLean [19] proposed an updated D&M model and argued that using “intention to use” in place of “use” can be an alternative in some contexts. In their updated model, these authors also incorporated service quality along with the system characteristic variables, which captures user’s perceptions of the overall support and services provided by the IS provider. In general, there is support for the D&M model [13, 78], though a few studies show mixed results, e.g., Web site success may depend on its context and goal [60].

Although information quality, system quality, and service quality may affect the first-time adoption of an IS, the link between “satisfaction” and “intention” needs to be understood in the terms of *continued use*. Further, continued use is necessary for an IS to be truly able to generate net benefits [8]. Following this argument, we use “intention to continue using” for operationalizing the “intention to use/use” variable in the updated D&M model.

Bhattacharjee [8] found that satisfaction mediates the beliefs toward the IT attributes of a system (i.e., PU) and intention to continue using the system. Similarly, Bhattacharjee and Premkumar [9] suggested that beliefs and attitudes toward a system will change based on the level of disconfirmation and satisfaction. Hence, the satisfaction–intention relationship suggested by the updated D&M model can be appropriately used to predict intention to continue using a system in the postadoption stage.

Our study proposes two dimensions of trusting beliefs (or trust) in e-government Web sites—namely, “trust in government” and “trust in technology.” Within DeLone and McLean’s [19] framework for IS success, we examine the role of trusting beliefs of users’ in e-government Web site affecting the quality perceptions of an e-government Web site, which in turn influence the users’ “satisfaction” and “intention to continue” using that Web site. With reference to the D&M model, the links between the three variables of Web site quality perceptions—information quality, system quality, and service quality—and two dependent variables—user satisfaction and user intention to continue—are explored. Figure 1 shows the research model and hypotheses to assess e-government Web site success.

## Dimensions of Trust in E-Government Web Sites

Trusting beliefs that an e-government Web site will act responsibly when a citizen visits or transacts with it are central to e-government Web site success. Trust has been defined as “a set of expectations shared by all those in an exchange” [79, p. 54]. It has a major impact in relationships between transacting groups. It is believed that the trusted party will behave in a socially responsible manner to meet the expectations of the trusting party. Trust is an expectation that alleviates the fear that one’s exchange partner will act opportunistically [10, 44]. These definitions take the perspective where the interacting partners are “individuals or groups.” But the concept of trust has wider implications. It can be used with reference to an object of use; for example, technology that is a surrogate (or proxy) for direct, face-to-face government interaction. Sitkin and

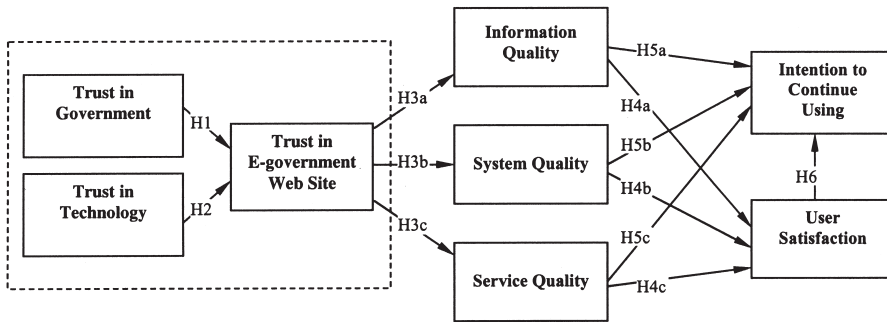


Figure 1. Research Model

Roth [64] define trust as a set of expectations that tasks will be accomplished reliably. In the context of technology, trust in technology implies believing that the technology can be used to get the desired task accomplished satisfactorily. Hence, there are two dimensions of citizen's trusting beliefs toward an e-government Web site—trust in government and trust in technology [11, 65].

### Trust in Government

Commercial Web sites are much more than their technological interface. More often than not, it is the quality of the relationship among the transacting parties that constitutes the foundation of trust for most online interactions. Similar to the situation where the success of an e-vendor's Web site is influenced by the online customer's trust toward that vendor [41], the success of an e-government Web site is also affected by citizen's trust in the government entity. The government–citizen relationship plays a central role in the formation of trust in government Web sites leading to their consequent success. Hence, citizen's trust in government should directly affect his or her trust in government Web sites. Further, past research has found that trust in a service representative (akin to trust in government) is positively related to trust in e-customer service (akin to trust in e-government Web sites) [70].

In other words, an e-government Web site is actually a proxy for the government providing public services to citizens through traditional offline channels. Therefore, if a government shows sincere care for the citizens and is able to effectively conduct its services, citizens are more likely to believe that the e-government Web sites developed and maintained by the government will be able to serve their needs. On the contrary, if a citizen's trust in the government is low, he or she will tend to doubt the policies made and actions taken by the government. E-government is a government-sponsored initiative, hence, trust in an e-government Web site emanates from the trust in government. Hence, it follows that

*Hypothesis 1: Trust in government is positively associated with trust in an e-government Web site.*

### Trust in Technology

Trust in the other party online is necessary, but not sufficient, for Web site users to form the belief that tasks will be completed successfully in the online environment. There are also concerns about the reliability of the Internet infrastructure. Trust in technology is the extent to which the Web site users trust the competence and security of the Internet. Past literature has discussed different sources of risks in transactions over the Internet, especially risk of privacy and security [6, 50]. Privacy risk pertains to the loss of control over personal information. If the citizen does not feel safe in providing private information through the Internet, then he or she is unlikely to expect successful completion of online transactions with the government Web site. Security risk, on the other hand, refers to the safety of the computer and the credit card or financial information. If the citizen does not believe that the technology applied by the government Web site is secure enough, he or she will be worried about the leakage of ID and password, computer viruses, or his or her credit card number being hacked. On the contrary, a high level of trust in technology will facilitate citizens' belief that online transactions and interactions with government agencies can be conducted successfully. It follows that

*Hypothesis 2: Trust in technology is positively associated with trust in an e-government Web site.*

### Trust and Quality Perceptions

The relationship between citizen's trusting beliefs and Web site quality perceptions can generally be explained by taking recourse in the attribution theory, which addresses the perceptions and inferences that arise as people try to explain the actions of others or themselves [36, 37]. Attribution theory suggests that the causes of actions are attributed to *internal* characteristics of the other person when the behavior is consistent with prior beliefs, and the causes are attributed to *external* situational reasons when the behavior is inconsistent with prior beliefs [35]. Dirks and Ferrin [22], in their trust model, make the assumption that trusting belief reduces ambiguity and uncertainty in social perceptions thereby facilitating positive attitudinal and behavioral outcomes. Hence, in a task-related environment, high levels of trust will cause the trustor to hold positive attitudes and result in a high perceived task quality whereas low levels of trust will yield low levels of perceived task quality [34]. Similar results in a marketing research scenario were reported by Weiner and Mowen [76]. In the context of e-government, an e-government Web site provides online information and services for citizens. A citizen will form subjective perceptions toward such information or services, as there is not always a clear way to ascertain the quality. The perceptions of quality of an e-government Web site will be based on the trusting beliefs of the citizen toward the e-government Web site, which may also be the result of his or her previous interactions with the same or related agencies.

Griffin [32] describes attribution as a three-step process that facilitates the formation of quality perceptions. The three steps are perception of interaction, judgment of



interaction, and attribution of qualities. Clearly, consistent with the attribution theory, the trustor (citizen) in a high trust environment is likely to attribute flaws and errors on the Web site to *external* reasons and tends to be less demanding in Web site functionality. On the contrary, if a citizen doubts the intention or commitment underlying the e-government Web site (an environment of low trust), any flaws can be attributed to perception of low quality (*internal* reasons). Such association between trust and quality perceptions is also evident from previous research. In a study of Internet stores, Gounaris et al. [31] find trust to be the strongest antecedent of all the four dimensions of perceived e-quality—information, user-friendliness, adaptation, and aesthetics. Trust in the online entity also has an influence on the attribution of the risk perception, which in turn affects the attitudes toward the company positively [63, 72]. Further, Urban et al. [71] emphasize that trust in the Web site is essential in engendering belief in the information provided by the Web site. Hence, a citizen's trusting beliefs will affect his or her perceived *information quality*, *system quality*, and *service quality* of an e-government Web site.

#### Trust and Information Quality

Information quality denotes citizen's assessment of whether the information on the Web site is accurate, valid, and timely. However, citizens may not always have objective criteria to make such an assessment and may have different interpretations of the information presented on the Web site. A lack of citizen's trust in an e-government Web site will cause him or her to have concerns: (1) whether the government agency is publishing accurate and timely information on its policies and programs, and (2) whether these policies and programs are by themselves trustworthy, or there is some hidden political purpose other than for the best interests of citizens. Past research in other contexts has consistently highlighted the positive impact of trust between partners on the perceived accuracy of information [7, 58]. Therefore, perceived information quality in an e-government Web site should vary based on the level of citizen trust.

*Hypothesis 3a: Trust in an e-government Web site is positively associated with the information quality of that Web site.*

#### Trust and System Quality

In addition, trust will affect the perceived system quality of an e-government Web site. Past research in other contexts has found high levels of trust to be positively associated with the performance perceptions of different organizational systems [43, 59]. The context of e-government is similar to that of e-commerce, where trust has been argued to reduce customer's need to understand, monitor, and control the situation for making online transactions effortless [51]. Trust in an e-vendor involves the belief that the e-vendor will take the responsibility to ensure the technical reliability and ease of use of a Web site, thus leading to higher perception of the system quality for that Web site. Extrapolating from this argument, since citizens are uncertain about the detailed technical features and also the various benchmarks for an e-government Web



site, trust enables citizens to believe that the government agency that runs the Web site will be able to effectively address various technical issues for enhancing the Web site usability. It follows that

*Hypothesis 3b: Trust in an e-government Web site is positively associated with the system quality of that Web site.*

### Trust and Service Quality

Trust in e-government will also affect perceived service quality of an e-government Web site. In studying trust in virtual teams, Jarvenpaa et al. [34] argued that if trust exists among team members, then errors are more likely to be attributed to *external* factors. In the context of e-government, service quality perceptions involve interactions between citizens and government officials. Following a similar line of argument, if trust in e-government is high, citizens are likely to be more tolerant and less demanding, and thus attribute negative experience (e.g., transaction delay or prolonged application processing time) to reasons other than poor service. Summarizing the preceding discussion, we hypothesize:

*Hypothesis 3c: Trust in an e-government Web site is positively associated with the service quality of that Web site.*

## Quality Perceptions and Satisfaction

This study then posits that citizen's perceptions of Web site attributes—that is, information quality, system quality, and service quality of an e-government Web site—are related to citizens' satisfaction and intention to continue using the Web site.

### Information Quality and Satisfaction

Information quality of a government Web site is the quality of the content provided on the Web site. Online information dissemination is the primary function of e-government. A U.S. survey has shown that "looking for information" accounts for 63 percent of total online activities with e-government Web sites [48]. This suggests that searching for information is the most common reason for citizens to visit e-government Web sites and, thus, in many cases, citizens are using e-government Web sites for their informational needs. It follows that

*Hypothesis 4a: Information quality of an e-government Web site is positively associated with satisfaction toward that Web site.*

### System Quality and Satisfaction

While information quality denotes citizen's perception of the quality of Web content presented on an e-government Web site, system quality denotes the citizen's perception

of the technical performance of the Web site in information retrieval and delivery [61]. A technically sound government Web site should provide easy and prompt access to information as well as reliable and secure functioning. System quality is an important determinant of Web site users' satisfaction [45] and intention to continue using [60]. In the context of e-government, system quality of an e-government Web site can be information accessibility, flexibility, response time, usability, integration, and so on. A citizen is unlikely to be satisfied if he or she has experienced problems in navigation or has to wait a long time for loading of Web pages.

*Hypothesis 4b: System quality of an e-government Web site is positively associated with satisfaction toward that Web site.*

### Service Quality and Satisfaction

E-government should not only be regarded as mere automation of the existing services provided by the government but it is also about transforming the current service delivery and reengineering processes within the government [66]. Thus, an e-government Web site can be analogically compared to a service agency with an IT interface that delivers services online. These services can include many interactions and transactions with the government, such as payment service, tax filing, passport application, and so on. Further, services can also be provided for e-participation, which involves engaging citizens in the operation of the government by means such as online forums [29]. The government officials behind the e-government Web sites are involved in delivering these services, including updating information, answering questions, providing feedback, and handling applications. Therefore, service quality of an e-government Web site should include the overall service delivered by the government agency through the Web site regardless of whether interaction and transaction with the government agency are involved. In the field of e-commerce, service quality is found related to customer's satisfaction of online experience [78]. Extrapolating from these arguments, we propose that service quality influences citizen's satisfaction of an e-government Web site.

*Hypothesis 4c: Service quality of an e-government Web site is positively associated with satisfaction toward that Web site.*

### Quality Perceptions and Intention to Continue

Given that quality perceptions have been found to have a positive relationship with behavioral intention to use an IS [19], the relationship is likely to hold true in the continuance context as well. Since the quality perceptions are largely formed through previous experiences with the Web site, in the postadoption stage, quality perceptions can have direct impact on users' future intention to use the Web site or not. This will be especially true where citizens have the option of switching back to alternative means of accessing government services (offline channels).

Quality perceptions (information quality, system quality, and service quality) should have a direct influence on users' intention to continue using, although their actual effects may vary across different situations. For example, if a citizen has the experience of finding inaccurate information on an e-government Web site, his or her belief toward the Web site's information quality will certainly hamper his or her intention to use the Web site again when he or she has a similar need the next time. In other words, the belief whether a Web site is "qualified" to help with certain tasks will influence the continuance decision. Similarly, if a citizen feels that an e-government Web site is cumbersome to use or the government staff behind the Web site are unwilling to provide sincere help, he or she may prefer using alternative offline channels, such as making telephone inquiries or conducting transactions in person. The preceding discussion leads to the following hypotheses:

*Hypothesis 5a: Information quality is positively associated with the intention to continue to use that Web site.*

*Hypothesis 5b: System quality is positively associated with the intention to continue to use that Web site.*

*Hypothesis 5c: Service quality is positively associated with the intention to continue to use that Web site.*

## Satisfaction and Intention to Continue

The purpose of an e-government Web site is to provide "quality public services and value-added information to citizens" [42, p. 99]. Hence, the success of an e-government Web site is contingent on the citizen's satisfaction and continued usage of the e-government Web site. Satisfaction toward an e-government Web site measures a citizen's psychological or affective state related to and resulting from a cognitive appraisal of the experiences with that Web site [8]. DeLone and McLean [18] used "satisfaction" to capture an IS user's cumulative satisfaction with the experience of using IS over time, which implies that satisfaction is regarded more as a long-term factor. Seddon defined satisfaction in the D&M model as "a subjective evaluation of the various consequences evaluated on a pleasant-unpleasant continuum" [61, p. 246]. In contrast, intention to engage in a certain behavior denotes the motivational factor that captures how hard a person is willing to try to perform a behavior [24]. A citizen's intention to continue using an e-government Web site is similar to a Web site user's revisit or repurchase intention [27]. In the postadoption stage, user's intention to continue using a Web site (1) follows the previous decision of using the Web site, indicating a repeat behavior mechanism; and (2) is influenced by the evaluation from previous use of the Web site, indicating a feedback mechanism [40]. In light of this argument, the link between "satisfaction" and "intention to continue using the IS" in the D&M model can be explained through the feedback mechanism where satisfaction, as an affective state formed from prior use, will influence user's intention to continue using the Web site in the future. Previous research has also explained the satisfaction-intention link

based on TRA where satisfaction is conceptualized as an attitude preceding the actual behavior [56]. Applied to the context of e-government, for example, if a citizen has had a pleasant and easy experience of finding the information needed from an e-government Web site, he or she is more likely to use the Web site the next time he or she needs similar information. This leads to the following hypothesis:

*Hypothesis 6: The level of satisfaction with an e-government Web site is positively associated with intention to continue using that Web site.*

## Method

FOR OUR RESEARCH, WE ADAPTED VALIDATED SCALES from existing literature where psychometric properties have already been established (Table 1). We used a seven-point Likert scale for measuring the items. Data were collected through questionnaires distributed to 214 university students in Singapore. The participants were solicited from a cross-faculty module (module taken by students from various faculties) in a large university. Note that students had a free choice to participate either in our study or other similar studies. We also screened students to ensure that they were continued users (rather than first-time users) of e-government Web sites before they were allowed to participate in this study.

Singapore is an excellent place for this study because its e-government is relatively well developed [66]. Singapore is currently ranked seventh in e-government in the United Nation's Global E-government Readiness Report [29]. Singapore also ranked second in e-government in Accenture's surveys for three consecutive years [42]. Further, Singapore was ranked second (after the United States) in the 2007 e-government ranking by Waseda University [75]. According to a survey conducted by the Infocomm Development Authority (IDA) of Singapore in 2007, 89 percent of Singapore citizens used electronic means (e.g., using the Internet or e-mail) for interacting or transacting with government agencies [3]. This report also points out that the majority of e-government users in Singapore are between age 20 and 39. Hence, using university students as respondents closely approximates the age group range of the actual e-government users in Singapore.

There are several other reasons suggesting that using students as respondents for our study is appropriate and does not present a significant threat to validity, which may be a possibility in research in other contexts [30]. First, students in some studies are asked to respond to questions about situations that are imaginary or to which they are not familiar. In contrast, in this study, respondents were familiar with the Internet in general and e-government Web sites in particular. The respondents averaged 7.9 years of Web experience and 3.4 years of experience using e-government Web sites. Second, interaction with government Web sites is common for the young population in Singapore for various purposes, for example, education, national service, youth activities, and sports. Hence, it does not require the students to imagine an organizational scenario, which they may not have experienced. The respondents in this study, all of whom have sufficient experience with some government Web sites, are being asked

Table 1. Items and Sources

Item	Description
Trust in technology [46]	
TIT1	The Internet has enough safeguards to make me feel comfortable using it
TIT2	I feel assured that legal and technological structures adequately protect me from problems on the Internet
TIT3	I feel confident that encryption and other technological advances on the Internet make it safe for me to transact there
Trust in government [46]	
TGV1	I feel that government acts in citizen's best interest
TGV2	I feel fine interacting with the government since government generally fulfills its duties efficiently
TGV3	I always feel confident that I can rely on government to do their part when I interact with them
TGV4	I am comfortable relying on the government to meet their obligations
Trust in government Web site [73]	
TEG1	This Web site is trustworthy
TEG2	This Web site seems to be honest and truthful to me
TEG3	This Web site can be trusted
Information quality [62]	
IQ1	This Web site provides sufficient information
IQ2	Through this Web site, I get the information I need in time
IQ3	I am satisfied with the accuracy of this Web site
IQ4	Information provided by this Web site meets my needs
IQ5	Information provided by this Web site is in a useful format
IQ6	Information provided by this Web site is clear
IQ7	Information provided by this Web site is accurate
IQ8	Information provided by this Web site is up-to-date
IQ9	Information provided by this Web site is reliable
System quality [62]	
SQ1	This Web site is easy to use
SQ2	This Web site is user friendly
SQ3	I find it easy to get this Web site to do what I want it to do
SQ4	I believe that this Web site is cumbersome to use (reverse coded)
SQ5	Using this Web site requires a lot of effort (reverse coded)
SQ6	Using this Web site is often frustrating (reverse coded)
Service quality [55]	
SVQ1	This Web site provides dependable services
SVQ2	This Web site provides services at the times it promises
SVQ3	This Web site gives prompt service to citizens
SVQ4	This Web site is responsive to citizen's request
SVQ5	This Web site is designed with citizen's best interests at heart
SVQ6	This Web site is designed to satisfy the needs of citizens
Satisfaction [62]	
SAT1	How adequately do you feel this Web site meets your needs of interaction with the government agency?
SAT2	How efficient is this Web site in fulfilling your needs of interaction with the government agency?
SAT3	How effective is this Web site in fulfilling your needs of interaction with the government agency?
SAT4	Overall, are you satisfied with this Web site?

*(continues)*

Table 1. Continued

Item	Description
Intention to continue using [8]	
CONT1	I intend to continue using this Web site rather than discontinue it
CONT2	My intention is to continue using this Web site rather than use any alternative means (e.g., offline interaction with the government agency)
CONT3	I will not discontinue my use of this Web site

about real-life situations, in contrast to hypothetical situations in many other studies using student subjects. Third, 57.9 percent of respondents in our sample were male. This is close to the actual proportion of 57 percent male Internet users in Singapore [21], thereby eliminating any bias, if any, due to gender ratio. Fourth, online users tend to be younger and more educated than offline users of services [46]. This provides further support for the use of student respondents in our study. Fifth, to ensure that respondents took the survey seriously, the respondents were awarded course credits as an incentive for participation in the study. Further, we asked them to describe their experiences in using e-government Web sites in the form of an open-ended question in the survey. Of the 214 respondents, 201 (93.9 percent) provided detailed comments about their experiences in using e-government Web sites, which further indicates that respondents were experienced users of e-government Web sites. Further, we found no significant differences in demographic characteristics between those who provided comments and those who did not, thereby eliminating any response bias. Considering all of these factors, we conclude that for our study, the student sample was in fact an extension of the real-world scenario and provides a valid sample for our research. In our survey, respondents were asked to choose an e-government Web site that they had previously used, and to respond with reference to the chosen Web site.

To supplement the survey results, we also conducted five focus groups. We invited 50 students in all (for each focus group, we invited 10 participants). Out of these, a total of 45 participants turned up for focus groups. The aim of the focus groups was to gather more information about usage and perceptions of e-government Web sites. As a follow-up, to mitigate the limitations of the student sample, we also conducted 27 interviews with working professionals in Singapore. Some sample designations of interview respondents were assistant vice president, senior manager, business analyst, engineer, lawyer, and research scientist. The general procedure and the issues deliberated in the interviews were similar to focus groups. The only difference was that these interviews were conducted individually with each respondent. The comments were essentially similar to that obtained from the student sample.

## Results

PARTIAL LEAST SQUARES (PLS) WAS USED to analyze the data. PLS differs from the covariance-based structural equation modeling techniques (such as LISREL, EQS, or AMOS) in that PLS places minimal restrictions on measurement scales, sample

size, and residual distributions [14]. Another advantage is that the PLS analysis is distribution free and does not assume true independence of the variables, leading to more reliable results. PLS is also robust against other data structural problems such as skew distributions and omissions of regressors [12, 28].

## The Measurement Model

Testing the measurement model involves examining the convergent validity, discriminant validity, and internal consistency of the constructs. Convergent validity refers to the extent to which the items under each construct are actually measuring the same construct. Two methods were applied to assess convergent validity. First, item reliability was examined for each item, which suggested that the factor loading of each item on its corresponding construct must be higher than 0.55 [23]. As shown in Table 2, all items had a loading above the suggested threshold. Second, we assessed convergent validity by examining the average variance extracted (AVE) for each construct. The AVE for a construct reflects the ratio of the construct's variance to the total variances among the items of the construct. All AVEs (Table 3) were above the 0.5 threshold suggested by Fornell and Larcker [25].

Discriminant validity refers to the extent to which a given construct differs from other constructs. As all items loaded more heavily on their corresponding constructs rather than on other constructs (Table 4), discriminant validity was satisfied. Further, the square roots of all AVEs were much larger than correlations among constructs, thereby satisfying discriminant validity. Internal consistency was assessed using composite reliability. Compared to Cronbach's alpha, which assumes equal weights of all the items of a construct and is influenced by the number of items, composite reliability relies on actual loadings to compute the factor scores and thus provides a better indicator for measuring internal consistency. The composite reliability values (Table 3) for all constructs in the model were above the 0.7 threshold [25].

## The Structural Model

The path coefficients of the proposed model were estimated using PLS and are shown in Figure 2. The significance level of these path coefficients was calculated with the jackknifing method [14]. Trust in government, but not trust in technology, is found to be positively related to trust in e-government Web sites, explaining  $R^2 = 0.11$  of citizen's trusting beliefs toward the Web site. Hence, H1 is supported (path = 0.29,  $t = 2.79$ ,  $p < 0.01$ ) and H2 is not supported (path = 0.09,  $t = 0.21$ ,  $p > 0.05$ ). Citizen's trust in e-government Web sites is found to be significantly related to information quality (path = 0.58,  $t = 9.50$ ,  $p < 0.01$ ,  $R^2 = 0.34$ ), system quality (path = 0.27,  $t = 2.34$ ,  $p < 0.05$ ,  $R^2 = 0.07$ ), and service quality (path = 0.57,  $t = 7.37$ ,  $p < 0.01$ ,  $R^2 = 0.32$ ), thereby supporting H3a, H3b, and H3c.

The results also show that information quality is not significantly related to satisfaction (path = 0.17,  $t = 1.65$ ,  $p > 0.05$ ). Hence, H4a is not supported. System quality (path = 0.19,  $t = 3.38$ ,  $p < 0.01$ ) and service quality (path = 0.40,  $t = 3.79$ ,  $p < 0.01$ )



Table 2. Factor Loadings

	1	2	3	4	5	6	7	8
TIT1	0.032	-0.038	0.073	-0.068	0.096	0.011	<b>0.876</b>	0.094
TIT2	0.064	0.002	0.125	0.029	0.135	0.018	<b>0.879</b>	0.066
TIT3	-0.007	-0.017	0.054	0.048	0.249	0.116	<b>0.807</b>	-0.005
TGV1	0.150	0.041	0.197	0.002	<b>0.776</b>	0.083	0.263	-0.042
TGV2	0.057	0.194	0.255	0.183	<b>0.772</b>	-0.035	0.173	0.020
TGV3	0.006	0.123	0.114	0.165	<b>0.828</b>	0.109	0.132	0.190
TGV4	0.170	-0.005	0.034	0.028	<b>0.822</b>	0.110	0.045	0.148
TEG1	0.285	0.038	0.220	0.175	0.082	<b>0.765</b>	0.067	0.296
TEG2	0.247	0.006	0.196	0.188	0.105	<b>0.798</b>	0.003	0.207
TEG3	0.314	0.091	0.281	0.058	0.101	<b>0.780</b>	0.141	0.108
IQ1	<b>0.714</b>	0.228	0.067	0.121	0.012	0.093	0.072	0.143
IQ2	<b>0.652</b>	0.165	0.155	0.167	0.043	0.149	0.061	0.180
IQ3	<b>0.674</b>	0.068	0.278	0.115	0.201	0.292	0.021	-0.077
IQ4	<b>0.621</b>	0.214	0.334	0.194	0.072	-0.010	-0.019	0.339
IQ5	<b>0.694</b>	0.348	0.021	0.065	-0.003	-0.081	0.044	0.318
IQ6	<b>0.647</b>	0.452	0.056	0.061	0.104	0.025	0.007	0.290
IQ7	<b>0.745</b>	0.105	0.242	0.072	0.169	0.292	-0.038	0.011
IQ8	<b>0.720</b>	-0.048	0.282	0.105	0.064	0.194	-0.005	0.042
IQ9	<b>0.668</b>	0.080	0.235	0.100	0.113	0.397	0.050	-0.054

SQ1	0.408	<b>0.720</b>	0.093	0.197	0.004	0.043	0.103	0.093
SQ2	0.362	<b>0.758</b>	0.058	0.193	-0.028	0.060	0.049	0.087
SQ3	0.395	<b>0.583</b>	0.355	0.180	0.024	0.015	0.053	0.024
SQ4	0.059	<b>0.812</b>	0.093	0.030	0.072	0.071	0.013	0.057
SQ5	0.029	<b>0.878</b>	0.068	0.029	0.093	0.024	-0.125	0.063
SQ6	0.068	<b>0.835</b>	0.196	0.020	0.145	-0.025	-0.061	0.039
SVQ1	0.293	0.140	<b>0.723</b>	0.131	0.095	0.177	0.049	0.131
SVQ2	0.254	0.083	<b>0.700</b>	0.322	0.162	0.150	0.148	-0.098
SVQ3	0.184	0.155	<b>0.745</b>	0.288	0.114	0.233	0.054	-0.029
SVQ4	0.117	0.066	<b>0.716</b>	0.284	0.142	0.190	0.035	0.154
SVQ5	0.268	0.260	<b>0.628</b>	-0.017	0.196	0.087	0.218	0.280
SVQ6	0.291	0.268	<b>0.663</b>	0.017	0.166	0.087	0.054	0.298
SAT1	0.253	0.112	0.145	<b>0.808</b>	0.060	0.179	-0.067	0.172
SAT2	0.165	0.100	0.268	<b>0.835</b>	0.144	0.090	0.010	0.151
SAT3	0.110	0.168	0.259	<b>0.805</b>	0.133	0.096	0.040	0.253
SAT4	0.234	0.425	0.264	<b>0.507</b>	0.120	0.116	0.012	0.362
CONT1	0.111	0.235	0.136	0.205	0.076	0.225	0.092	<b>0.646</b>
CONT2	0.263	-0.067	0.116	0.296	0.035	0.089	0.086	<b>0.589</b>
CONT3	0.151	0.141	0.106	0.171	0.219	0.222	0.032	<b>0.658</b>

*Note:* Figures in boldface are factor loadings on a priori constructs.

Table 3. Descriptive Statistics, Composite Reliability, Average Variance Extracted

Construct	Mean	Standard deviation	Composite reliability	Average variance extracted
Trust in technology (TIT)	4.09	1.13	0.91	0.78
Trust in government (TGV)	4.85	0.89	0.91	0.73
Trust in e-government Web site (TEG)	5.64	0.77	0.95	0.85
Information quality (IQ)	5.44	0.75	0.93	0.60
System quality (SQ)	5.28	0.96	0.93	0.68
Service quality (SVQ)	5.18	0.85	0.92	0.67
Satisfaction (SAT)	5.25	0.90	0.94	0.79
Intention to continue using (CONT)	5.53	0.93	0.85	0.65

are significantly related to user satisfaction ( $R^2 = 0.42$ ), thereby supporting H4b and H4c. Among the quality perceptions, only information quality (path = 0.25,  $t = 2.90$ ,  $p < 0.01$ ) is found significantly related to “intention to continue” using the Web site, thereby supporting H5a. In other words, the relationships between system quality (path = 0.00,  $t = 0.87$ ,  $p > 0.05$ ) and service quality (path = 0.05,  $t = 0.76$ ,  $p > 0.05$ ) to “intention to continue” using the Web site are not significant. Hence, H5b and H5c are not supported. In addition, user satisfaction is significantly related to user’s intention to continue using the e-government Web site (path = 0.40,  $t = 5.07$ ,  $p < 0.01$ ), thereby supporting H6.

On the advice of a reviewer, we inserted direct paths from trust in government to the three quality variables. The results indicate that the relationship of trust in e-government with information quality (path = 0.53,  $t = 6.83$ ,  $p < 0.01$ ), system quality (path = 0.21,  $t = 2.96$ ,  $p < 0.01$ ), and service quality (path = 0.48,  $t = 4.69$ ,  $p < 0.01$ ) remains significant. In contrast, the relationship of trust in government with information quality (path = 0.16,  $t = 0.97$ ,  $p > 0.05$ ) is not significant while that for system quality (path = 0.18,  $t = 2.34$ ,  $p < 0.05$ ) and service quality (path = 0.30,  $t = 5.77$ ,  $p < 0.01$ ) is significant. The results indicate that the path coefficients between trust in e-government and the three quality measures are higher than that between trust in government and the three quality variables, thereby providing support for our original model. The results also suggest that trust in e-government acts as a partial mediator between trust in government and the three quality variables.

We also tested the direct effect of trust in e-government Web sites on satisfaction and intention to continue using, because several authors suggest that online trust may have direct effects on satisfaction [4] and behavioral intention [27]. Further, other researchers found a direct link between trust and e-loyalty [17]. The results indicate that trust in e-government has a direct relationship with satisfaction (path = 0.17,  $t = 1.81$ ,  $p < 0.05$ ) and intention to continue using (path = 0.21,  $t = 2.71$ ,  $p < 0.01$ ) as shown in Figure 3.

Table 4. Correlation Table

	TIT	TGV	TEG	IQ	SQ	SVQ	SAT	CONT
TIT	0.880							
TGV	0.373	0.852						
TEG	0.193	0.319	0.923					
IQ	0.127	0.319	0.580	0.773				
SQ	0.045	0.230	0.267	0.562	0.822			
SVQ	0.247	0.434	0.568	0.619	0.482	0.819		
SAT	0.088	0.339	0.470	0.523	0.476	0.598	0.886	
CONT	0.190	0.322	0.484	0.496	0.358	0.450	0.566	0.805

*Note:* The square root of AVE is shown on the diagonal.

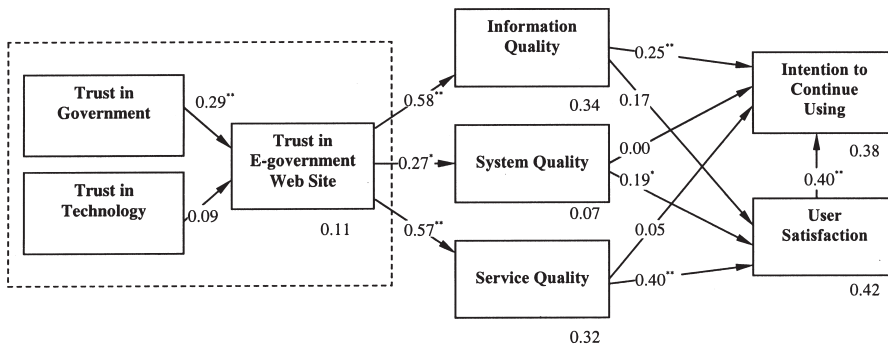


Figure 2. Path Coefficients  
 \*  $p < 0.05$ ; \*\*  $p < 0.01$ .

We also compared the modified model (Figure 3) with the original model in terms of  $R^2$  change for the two final dependent variables—“satisfaction” and “intention to continue using the Web site.” For  $R^2$  comparison, we used Cohen’s [15] formula for calculating effect size  $f^2$  as

$$f^2 = (R^2_{\text{included}} - R^2_{\text{excluded}}) / (1 - R^2_{\text{included}}).$$

The value of  $f^2$  captures whether the impact of a particular independent construct on a dependent construct is substantive. For the modified model,  $R^2$  for “satisfaction” increased from 0.42 to 0.43 ( $f^2 = 0.03$ ) and for “intention to continue using” increased from 0.38 to 0.40 ( $f^2 = 0.04$ ). The  $f^2$  value suggests that the modified model does not have significantly better predictive power than the original model [14]. The paths between trust in the e-government Web site and intention to continue using the e-government Web site and between trust in the e-government Web site and satisfaction are significant. Thus, the effect of trust on satisfaction is found to be partially mediated by system quality and service quality, and the effect of trust on intention to continue using is partially mediated by information quality.

Figure 4 examines the direct effects of trust in the e-government Web site on satisfaction and intention to continue using without the presence of quality perceptions constructs. This test confirms that the relationship between trust in the e-government Web site and satisfaction is partially mediated by system quality and service quality, while the relationship between trust in the e-government Web site and intention to continue using the Web site is partially mediated by information quality.

To further examine the robustness of the proposed model, we tested the direct effect of trust in government on satisfaction and intention to continue using. Our results indicate that neither the relationship of trust in government with intention to continue using (path = 0.11,  $t = 1.79$ ,  $p > 0.05$ ) nor with satisfaction (path = 0.10,  $t = 1.24$ ,  $p > 0.05$ ) is significant. This result provides support to our original contention that the relationship of trust in government with satisfaction and intention to continue using is fully mediated through trust in the e-government Web site and quality measures.

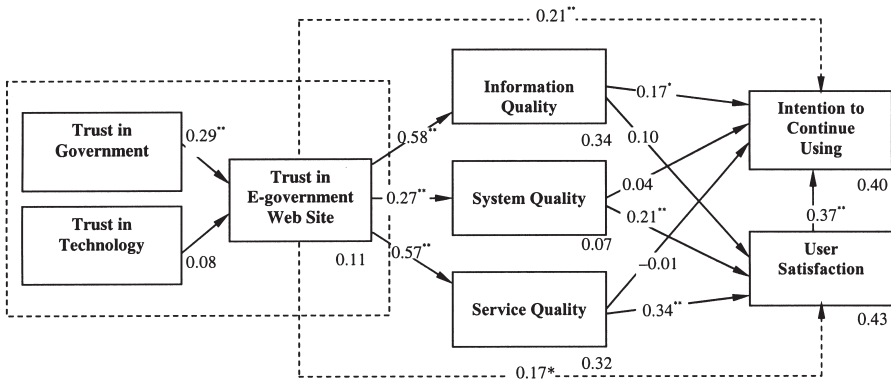


Figure 3. Analysis After Adding Direct Links from Trust in E-government Web Site to Intention to Continue Using and User Satisfaction (Modified Model)

\*  $p < 0.05$ ; \*\*  $p < 0.01$ .

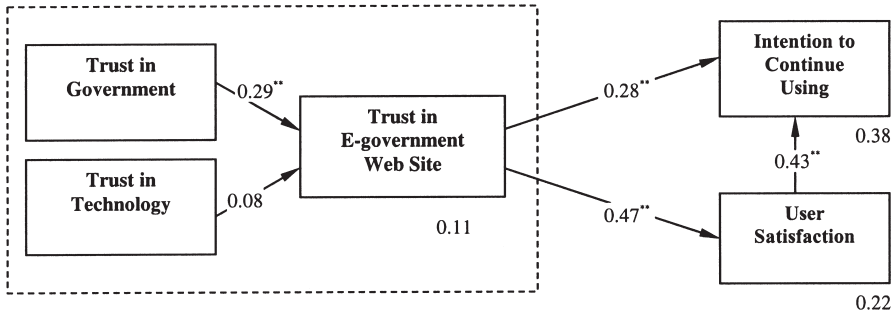


Figure 4. Testing of Direct Effect of Trust in E-government Web Site with Intention to Continue Using and User Satisfaction

\*  $p < 0.05$ ; \*\*  $p < 0.01$ .

This result provides robust empirical support for our proposed e-government success model.

### Post Hoc Analysis

Post hoc analysis was conducted to understand e-government usage by different types of users. We did this by splitting our sample into two subsamples based on different activities the respondents reported in using e-government Web sites. Four activities were identified in the survey questionnaire—browsing, downloading, messaging, and transacting [69]. The first two represented the information needs served by the e-government Web site in which the user has to *passively observe* and get information, and the last two involved interaction and transaction with the government agency through the Web site in which the users have to *actively engage* with the government agency through the Web site. From our data, we found that all of the survey respondents reported using

Table 5. Comparison of Active Users and Passive Users

Paths examined	Original	Passive	Active
Trust in technology → Trust in e-government Web site	0.09 (0.21)	-0.05 (0.86)	0.24 (2.21*)
Trust in government → Trust in e-government Web site	0.29 (2.79**)	0.35 (3.72**)	0.21 (1.82*)
Trust in e-government Web site → Information quality	0.58 (9.50**)	0.61 (9.21**)	0.55 (4.00**)
Trust in e-government Web site → System quality	0.27 (2.34*)	0.39 (5.40**)	0.13 (0.67)
Trust in e-government Web site → Service quality	0.57 (7.37**)	0.66 (11.91**)	0.46 (2.72**)
Information quality → Satisfaction	0.17 (1.65)	0.25 (2.12*)	0.09 (0.04)
System quality → Satisfaction	0.19 (3.38**)	0.05 (0.05)	0.36 (3.51**)
Service quality → Satisfaction	0.40 (3.79**)	0.47 (4.45**)	0.30 (1.84*)
Information quality → Intention to continue	0.25 (2.90**)	0.41 (3.52**)	0.08 (0.82)
System quality → Intention to continue	0.00 (0.87)	-0.02 (0.55)	0.04 (0.04)
Service quality → Intention to continue	0.05 (0.76)	0.12 (0.85)	0.00 (0.14)
Satisfaction → Intention to continue	0.40 (5.07**)	0.47 (2.41**)	0.52 (4.57**)
Sample size	214	122	92
Internet experience	7.90 (1.92)	7.89 (2.03)	7.92 (1.77)
Singapore e-government experience	3.37 (1.74)	3.36 (1.80)	3.39 (1.68)

*Notes:* Numbers in parentheses indicate the corresponding *t*-statistics and significance levels; numbers listed for Internet and Singapore experience indicate the mean with standard deviations in parentheses. \*  $p < 0.05$ ; \*\*  $p < 0.01$ .

e-government Web sites for information needs, but only 43 percent reported using e-government Web sites for interaction and transaction (active users). Therefore, the “active user” subsample contained 92 respondents who have used e-government Web sites for their interaction and transaction needs, and the remainder of users that used e-government Web sites only for their informational needs constituted the “passive user” subsample with 122 respondents. The results are shown in Table 5.

For the passive user group, the results are similar to that of the original sample, except that (1) information quality perception is significantly related to satisfaction and (2) system quality perception is not significantly related to satisfaction. For the active user group, however, “trust in technology” is found to be a significant predictor of citizen’s trusting beliefs toward an e-government Web site, and none of the quality



perceptions (information, system, or service) is significantly related to citizen's intention to continue using the e-government Web site. Further, a *t*-test was conducted to compare the means of Internet experience and Singapore e-government experience of the two subsamples. The *t*-statistics indicate that these two subsamples do not differ significantly for either Internet experience ( $t = 0.14, p > 0.05$ ) or Singapore e-government experience ( $t = 0.26, p > 0.05$ ).

## Discussion

OUR RESULTS INDICATE THAT TRUST IN GOVERNMENT, but not trust in technology, is significantly related to general trust in e-government Web sites.

Trust is definitely important for e-government. We have the least corrupted government in the world. You can simply follow what they say and there is no need to worry that your information will be abused. . . . I have confidence in our government, so I'm willing to use the e-service they provide.

This suggests that governments need to build trust in users by addressing users' needs as well by establishing a sound legal environment or setting up institutional trusting services for building trust [66]. Explicit promotion of e-government initiatives by top leadership has also been instrumental in building trust of citizens in e-government. One respondent remarked:

Leaders are promoting e-government very vigorously, be it provision of free wireless Internet access to citizens at Wi-Fi hot spots, educating people about computers, or even making filing of tax returns online almost mandatory. Their slogan now is YQ [why queue] and, of course, it saves a lot of time for the citizens. This gives me a certain degree of confidence in using the e-government Web sites.

On the other hand, the insignificant relationship between trust in technology and trust in e-government Web sites is similar to Lee and Turban's [41] finding that trust in the technology medium is not significantly related to customer's intention to do online shopping. This finding indicates that compared to trust in government which plays the role of the online trustee, trust in technology appears to play a less salient role in determining whether an e-government Web site is trustworthy. One respondent mentioned:

I don't quite trust technology. There are many "fraud Web sites" these days and you may never know where your information actually goes. . . . But I'm quite sure that the government is making efforts to ensure online security for their Web sites, so I don't worry much about technology when I use these Web sites.

In addition, this study finds that trust toward an e-government Web site is significantly associated with perceived Web site quality—that is, information quality, system quality, and service quality. Among the success variables in the D&M model, only information quality perception is directly related to intention to continue using

a particular e-government Web site. This finding can be explained by the nature of e-government Web site usage. A citizen uses an e-government Web site for information search or online services that involve transactions with the government agencies, hence fulfilling citizen's information and transaction needs are the two basic functions of an e-government Web site [42]. However, information needs and transaction needs differ in frequency and mandate level. A lot of useful public information is available on many Singapore e-government Web sites. Several respondents highlighted the preponderance of their informational needs in using government Web sites.

Thus, searching for information is the prime reason for citizens visiting e-government Web sites in Singapore. Hence, most citizens' interactions with e-government Web sites are one-way, where they do not need to provide their private information through these Web sites. Some citizens use e-government Web sites for checking personal statements, etc., generated by the government, such as the Central Provident Fund (CPF)—a social security savings fund) statements and balance sheets. Tasks that involve getting information from e-government Web sites have a greater degree of voluntariness (as compared to some mandatory activities such as filing tax returns), hence, citizens can exercise their option of using or not using these Web sites for future similar interactions with the government. Thus, information quality perception of the e-government Web site is related to continuance intention of the citizens for using the Web site. If citizens find information from the e-government Web site to be useful, they might be motivated to use it for their future informational needs. As a respondent commented:

Singapore e-government Web sites provide rich information and statistics so I used them for some research projects. I used [singstats.gov](http://singstats.gov) to check regional economic data for my project in the "Asian Global Economy" course. It's a very rich information source and I believe it will be helpful for my future projects.

In contrast to the scenario for citizens' informational needs, some online services may be relatively mandatory in nature as there are fewer convenient alternatives available. The degree of voluntariness for choosing whether to use such online services is much lesser.

Hence, in contrast to information quality, system quality and service quality are not significantly related to continuance intention. Users appear to be more tolerant toward system quality and information quality because of the near mandatory nature of the tasks for which they may be using e-government Web sites. Many government services are characterized by such near mandatory use of online services since the only alternative for citizens who choose not to use the online services may involve visiting the government agency and spending several hours waiting in the queue. Hence, system quality as well as service quality may not be important considerations for their intention to continue using the Web site as long as these Web sites provide the necessary functionality and make the online option more convenient than the offline option. This situation is very different from the situation encountered in using e-commerce Web sites where the buyers may have multiple options from which to choose [78].

Further, citizens using the transactional provisions of the e-government Web sites may be more IT savvy, and hence may have better perceptions of system quality and

service quality. This aspect is also indicated by the fact that only system quality and service quality are found to be significantly related to satisfaction, while information quality is not. Information quality is more strongly associated with the *routine requirements* of the citizens, whereas system quality and service quality of Web sites are associated with *deeper use* of the online facility. Hence, a better system quality and a better service quality are related to user satisfaction, as is evident by the following quotation:

They [the CPF Web site] are supposed to give right information to us. As I use CPF for statements, when I have a question with the numbers, I will e-mail them and they will come back to me within three days. They're responsive, and they do answer your questions. That's why I'm satisfied . . . not only because they provide the statements online.

The Singapore government aims to be a world-class exploiter of IT [66] and has made an early start in e-government. The public has been able to interact with the government through the eCitizen Portal ([www.ecitizen.gov.sg](http://www.ecitizen.gov.sg)) since 1999. Up to the year 2006, a total of 157 e-government Web sites were listed on the Singapore e-government portal ([www.igov.gov.sg](http://www.igov.gov.sg)). Most e-government initiatives start by providing information cataloging and then move on to online transaction services [57]. It can be extrapolated from this argument that Singapore e-government Web sites are already at a fairly mature stage where online public information is regarded mostly as a fundamental function of these Web sites. Thus, satisfaction toward these e-government Web sites is more likely to be determined by the services provided by the Web sites rather than by the information available on these Web sites.

The results also show that the relationship between trust and satisfaction is partially mediated by system quality and service quality, while that between trust and intention to continue using is partially mediated by information quality. This finding suggests that building user trust is necessary for e-government Web site success, but trust will affect e-government Web site success through different mechanisms. Methods to build trust will directly enhance user's intention to continue using an e-government Web site. On the other hand, if the government agency fails in establishing user's trusting beliefs toward its Web site, then it may have difficulty in encouraging users to continue using the Web site in the future because users may doubt the information provided on the Web site. However, trust does not have direct relationship with satisfaction. This implies that users may be satisfied as long as they feel that the online services meet their needs well. For example, in online tax filing, a user may be satisfied as long as the transaction is completed successfully. The user's trusting beliefs in the tax filing Web site may not necessarily affect his or her satisfaction, as the latter is more affected by the system and service quality perceptions of the Web site.

The post hoc analysis found that trust in technology is a significant predictor of trust in e-government Web sites for active users but not for passive users. Because active users use e-government Web sites for interactions and transactions, they are likely to be exposed to higher levels of risks associated with the online transaction environment. For them it is imperative to trust the technology to feel comfortable when sharing personal information such as credit card numbers and the like on the Web.

One active user who used e-government Web sites for both information search (e.g., tax information) as well as transactions (e.g., tax filing) commented:

Technology doesn't matter much when I search information, but it definitely matters if I need to provide my ID, password, or account number to the Web site. I keep using online tax filing because I think the SSL [secure sockets layer] security system is good enough for me to trust the technology.

Further, trust is found not significantly related to system quality perceptions for active users. A possible reason is that active users have a higher level of interaction with the technology and thus are likely to form perceptions of system quality based more on their evaluation of the design or functionality of the Web sites. In contrast, for passive users, when it comes to information search and downloading, system quality is more likely to be interpreted as the belief of whether the arrangement of Web site functions helps and facilitates the users to locate and find the information they are looking for. Thus, if a citizen trusts the e-government Web site, he or she is more likely to form high perception of system quality.

The post hoc analysis also found that information quality is significantly related to satisfaction for passive users but not for active users, while system quality is significantly related to satisfaction for active users but not for passive users. This again indicates the different roles of quality variables. For passive users, information search is the main purpose of usage and thus the overall satisfaction is more affected by whether the information on the Web site is accurate and updated. Meanwhile, serving citizens' informational needs does not require a high level of technical involvement. In comparison, the impact of system quality appears more salient for active users.

In addition, none of the quality perceptions are found directly related to "intention to continue using" for active users at  $p = 0.05$ . For active users, information quality is less important for continued usage than for passive users, whose main purpose of using an e-government Web site is to search for information. This result is consistent with Mithas et al. [47], who found that content-loyalty relationship is stronger for information-oriented Web sites (analogous to passive users) than for transaction-oriented Web sites (analogous to active users). Further, when more or less mandatory transactions are involved, quality perceptions may not affect the decision to continue usage because the decision in such a case is more likely to be made on the need to complete the task.

In summary, the post hoc analysis shows that different nature of usage will affect the relationships among the variables associated with e-government Web site success, suggesting that future research should incorporate types of usage in examining Web site success.

## Limitations

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THIS STUDY HAS THREE LIMITATIONS. First, this study mainly focuses on the direct effects of trust on IS success variables in the D&M model. However, the interaction effect of trust with other variables may provide further insights [22, 34]. Since users' needs

are the ultimate reason for them using e-government Web sites and quality perceptions may serve as proxies for these needs, it may also be posited that trust plays a moderating role in assessing e-government Web site success, that is, users with high trust toward e-government may have different patterns of usage compared to those with low trust. This issue can be examined in future research.

Second, this study is based in Singapore, which is a small country compared to many other countries having multiple layers of government. Future research can explore the importance of trust in e-government for different levels (federal, local, etc.) in a different country.

Third, this study uses a student sample. Although we have tried to mitigate the drawbacks of a student sample through the use of focus groups and individual interviews with practitioners, the fact remains that a student sample may not be entirely representative of e-government users. Future research can collect data directly from citizens using e-government Web sites.

## Implications for Research

THERE ARE SEVERAL IMPLICATIONS FOR RESEARCH emerging out of this study. First, this study extends the online trust literature into the e-government context. The results reveal that citizen's trusting belief is an overall antecedent of e-government Web site success by directly affecting the formation of Web site's quality perceptions. This finding is similar to the notion that trusting beliefs affect PU and PEOU in the e-commerce context [27]. Both findings indicate that when Web site users receive e-services, their attitude and perception toward these services will be affected by trust. This study further reveals that trust will affect different categories of quality perceptions—that is, information, system, and service quality. As government agencies are providing an increasingly broad range of information and services through their Web sites, it is necessary to understand that investment in building citizen trust is important for utilization of all these services. However, how trust affects different types of e-government services still requires further research.

Second, this study broadens our understanding toward online trust in the e-government context by hypothesizing the different effects of “trust in government” and “trust in technology.” A similar attempt undertaken by Lee and Turban [41] also found an insignificant relationship with trust in technology for online shopping. However, dividing our sample into passive users and active users provides deeper insights. Our findings indicate that trust in technology has a significant relationship with trust in e-government Web sites for active users but not for passive users. Given that numerous studies have theorized multiple facets of trust [27, 46], this study implies that the effect of different trust antecedents can vary under different nature of usage. Such contextual effect of online trust requires further research.

Third, extrapolating from the online trust literature, especially the business-to-consumer (B2C) context, the results of this study suggest that more research should be done on the role of citizen trust for e-government success. While the current study mainly focuses on the government-to-citizen (G2C) relationship, e-government is a

global trend and covers a number of domains. Intuitively, trust will also matter in the government-to-business (G2B) context where e-procurement with business partners is involved, as well as the government-to-government (G2G) context where different government agencies need to cooperate for new government processes. Future research could examine the role of trust in different e-government domains which may be somewhat different from the typical commercial e-commerce context.

Fourth, this is one of the first studies to extend the updated D&M model by integrating trust as an overall antecedent of quality perception variables. DeLone and McLean [19, 20] claimed that the updated D&M model is applicable to the e-commerce context, whereas our findings suggest that incorporating trust in the updated D&M model can provide a more complete understanding of e-government Web site success. However, the role of trust in an online environment still requires further research, especially for the e-government context.

Fifth, this study shows that trust could be integrated into the updated D&M model for conceptualizing and investigating Web site success in a G2C context also. Given that the Internet has already penetrated our daily lives and many new trends of Internet applications are emerging, the D&M model may also be suitable for assessing IS success in other contexts. Thus, future research should continue to test and refine the D&M model.

Sixth, this study respecifies the updated D&M model to understand success at a postadoption stage and suggests that placing "intention to continue using" can be a worthwhile alternative to the controversial "use" construct in the D&M model.

Finally, the results report a few insignificant relationships suggested by the D&M model, which calls for a deeper understanding of the nature of use. The results of the post hoc analysis suggest that the interrelationships among the quality perceptions and recipient side variables (intention to continue using and user satisfaction) under the updated D&M model may be contingent on the "nature of use." However, no study has explicitly addressed to what extent "IS use" should be conceptualized, as well as how to break the "IS use" construct as users may enact different understandings of usage even toward the same technology [49]. Future research can examine these findings in greater depth.

## Implications for Practice

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THE RESULTS ALSO HAVE IMPLICATIONS for government agencies that are providing or planning to provide online service delivery. The government agencies are currently facing the challenge of keeping the citizens motivated enough to continue using their e-government Web sites. Our results indicate that in addition to IT attributes, building trust is crucial for users' continued usage of e-government Web sites. Further, different IT attributes of e-government Web sites play different roles in user's continuance intention. In addition to online mechanisms, offline trust-building mechanisms are indispensable for the success of any e-government endeavor. User's quality perceptions of an e-government Web site will largely depend on his or her trusting beliefs; hence, governments need to take appropriate action for establishing such trusting beliefs. In

the context of Singapore, the government has long been dedicated to building trusting relationships with users when implementing e-government. For example, the National Trust Council (NTC) was formed in February 2001 and it implemented the first nationwide TrustMark Program—the TrustSg seal (which provides assurance that online vendors will honor their promise and deliver what is ordered). The government has also made efforts to establish citizen trust in e-government by manifesting top leadership commitment and raising user awareness about e-government. For example, at the launch of the e-Government Action Plan II (eGAP II) in July 2003, Deputy Prime Minister Hsien Loong Lee (now the prime minister) stated:

Ultimately, eGAP II is not about IT, but about changing the approach to Government. The default answer to any request is not to say “no” and preserve the status quo, but to ask why the status quo should be maintained. . . . This is the biggest change we are aiming for, which will go a long way to remaking Singapore. ([www.igov.gov.sg/NR/rdonlyres/569319CF-F7E1-4ACF-B745-D20E083AAFAF/4456/DPMSpeechatLaunchofeGAPII.pdf](http://www.igov.gov.sg/NR/rdonlyres/569319CF-F7E1-4ACF-B745-D20E083AAFAF/4456/DPMSpeechatLaunchofeGAPII.pdf))

In addition, government agencies need to pay attention to the different roles of the IT attributes presented on an e-government Web site. Policymakers should note that providing relevant and accurate information is of vital importance for user’s continued use of an e-government Web site. Compared to transactions or other administrative duties, information search is often much less mandatory and users can turn to alternative means (e.g., via telephone) if they fail to find the information they need from the e-government Web site. Therefore, government agencies also need to focus on the efficiency and effectiveness of their Web content updating process. By comparison, for online transactions, users may have fewer alternatives for certain online government services, such as an application for Sing pass or an application for economic restructuring shares. For other services conducted on a regular basis, such as the CPF or tax filing, users may habitually use online services, since offline transactions can be much less convenient. Therefore, government agencies should focus on the reliability of their online service processes. Further, for government agencies where user satisfaction accounts for their performance measurement, service quality and system quality needs to be emphasized.

## Concluding Remarks

BY INTEGRATING THE ONLINE TRUST LITERATURE with the updated D&M model, this study proposes and tests a model to assess e-government Web site success at the postadoption stage. The results suggest that quality perceptions of citizens toward a particular e-government Web site are affected by their trust in e-government Web sites. This study also finds that online trust is partly affected by the offline trust in the government. Therefore, while Web site attributes, such as information quality, system quality, and service quality perceptions, are usually regarded as key success factors having effects on the final outcomes of e-government in terms of efficiency and effectiveness, these perceptions are in fact dependent on the trusting relationship between users and the



government. Hence, government agencies need to emphasize trust-building mechanisms in retaining users for their online public services.

Previous IS literature has researched both trust and the D&M model, but to our knowledge, the current research is the first study to combine these two research streams in the context of e-government. By taking “satisfaction” and “intention to continue using” as two final dependent variables, this study finds that factors from both streams of literature are not only good predictors but also inexorably intertwined. Future research can provide a broader and deeper view of how countries can successfully engage users in their e-government endeavor.

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