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Adoption of electronic government services among business organizations in Singapore

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Abstract

With the global emergence of public sector information communication initiatives, there has been a growing need for research on factors influencing adoption of e-Government services. To fill up the existing knowledge gap in this area, this paper examines factors influencing adoption of electronic government services among business organizations in Singapore. Drawing on Rogers' Innovation Diffusion Theory and on the literature on network externalities, social influence, and barriers to adoption, this paper develops a theoretical framework and proposes that perceived benefits, management readiness, sensitivity to cost, external pressure, and social influences are positively related to the adoption decision. We tested this framework using survey data from 128 business organizations in Singapore. The results show a significant positive relationship between perceived benefits, external pressure, and social influence and the firms' decision to adopt e-Government services. Some possible implications of our study are that governments need to increase public awareness of direct and indirect benefits of their e-services, to portray e-services as up-to-date, effective and secure, and to put in place various incentives to encourage their adoption.

Keywords: e-Government; e-Services; Network externalities; Social influence; Barriers to adoption; Diffusion of Technology

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1. Introduction

E-Government, defined as 'information system aided handling of public administration processes using information and communications technology' (Rötter, 2003), is believed to lead to better delivery of government services, improved interaction with business and industry, citizen empowerment through access to information, or more efficient government management. The resulting benefits include increased accountability and transparency, less corruption, greater convenience, increased citizen involvement, greater efficiency, and cost reductions for both the government itself and the adopter of e-Government services. E-Government also facilitates the provision of new and enhanced services and encourages citizen participation in political processes (Gupta and Jana, 2003; Jaeger, 2003; Relyea, 2002; World Bank, 2003). Nevertheless, compared to many private sector organizations government agencies have been relatively slow in establishing and developing an online presence. A number of studies have tracked the effectiveness of governments in delivering public services online. Accenture's 2005 study of e-Government initiatives in 22 countries found that the average e-Government Maturity was 48%, with only two countries reaching 60% or above[1] (Accenture, 2005). As rated by West's e-Government Index (West, 2004), the same sample of countries reaches an average e-Government Index score of 31.7%, meaning that the average website contained just below one third of the features which West's study considered as important for information availability, citizen and portal access, and service delivery[2]. Finally, the UN Global E-Government Survey (2003) proposed a normalized 'Web Measure Index' to evaluate the aptitude of 191 governments to employ e-Government 'as a tool to inform, interact, transact, and network' (United Nations, 2003)[3]. The survey finds that the average government reaches only 25.5% of the highest ranking government's index score, with only seven governments reaching 75% and above.[4]

All three studies conclude that the provision of e-Government services is still far from reaching full effectiveness. Moreover, the Accenture and West studies found that the growth of e-Government service provision has rather slowed down in the past year, indicating that e-Government service efforts may plateau on a sub-optimal level.

The reasons for the comparably slow spread of e-Government services have been discussed in a number of studies (Accenture, 2003–2005; Jaeger, 2003; Moon, 2002; Reddick, 2004; Wescott, 2002). They include inertia, security and confidentiality, lack of

[1] Accenture's Maturity Score is a weighted index composed of Service Maturity (the level to which a government has developed an online presence) and Customer Service Maturity (the extent to which government agencies manage interaction with their customers and deliver service in an integrated way). The top scoring countries are Canada (68%) and the United States (both 62%), followed by Singapore and Denmark (both 56%).

[2] West's e-Government Index rates websites according to the presence of a set of 18 predefined features as well as on the total number of different services executable on that site. In his 2004 survey, West rates a total of 198 countries, out of which the top three ranked countries were Taiwan (44.3%), Singapore (43.8%), and the United States (41.9%).

[3] The Web measure Index is one component of a more comprehensive 'E-Government Readiness Index', the latter of which also includes measures of a nation's telecommunications infrastructure and human capital.

[4] The highest ranking government in this study was the United States government, attaining a normalized score of 1.

computer skills, difficulties in carrying out organizational change, and the nature of public sector financing and procurement practices.

Clearly, governments and the private sector differ greatly with regard to the pressures and incentives to provide online services. One major caveat of e-Government is that due to their public service obligations governments are typically not in the position to discontinue traditional paper-based processes as soon as online services are launched. The expected benefits of any given e-Government services are therefore unlikely to materialize immediately. Benefits such as increased administration efficiency and transparency can be realized only at the time when the majority (if not all) of the interaction with government regarding the service are conducted via the Internet. An understanding of the citizens' and business organizations' incentives to adopt e-Government services is therefore crucial for the success of any e-Government initiative.

While a significant body of academic literature exists on e-Government services, surprisingly little is known about why and under what circumstances citizens and corporations *adopt* them. The focus of the academic literature on e-Government up to date has rather focused on the supply side of e-Government. In particular, most previous research has looked at success factors and impediments of e-Government initiatives (Jaeger, 2003; Lowe, 2003; Siegfried, Grabow, and Drüke, 2003; Traunmüller and Wimmer, 2003), models of e-Government evolution and Growth (Reddick, 2004; West, 2004), as well as at practices, effectiveness of implementation and challenges of e-Government services (Jaeger and Thompson, 2003; Moon, 2002).

Although technology adoption from the user perspective has been studied extensively with respect to the Internet and to electronic commerce (EC), only scant academic research has been conducted specifically on the adoption of e-Government services by private individuals or businesses. Botterman et al. (2003) and Lassnig and Markus (2003) conduct international comparisons of e-Government usage. Hinnant and O'Looney (2003) incorporate demand side considerations into their study of the pre-adoption interest in e-Government personalization. Their research is however directed at a specific class of innovations related to e-Government services, i.e. the personalization of e-Government services, rather than on e-Government service adoption in general. Overall, the lack of systematic demand-side studies leaves governments with almost no information on how exactly to channel their efforts and financial resources in this area. It comes therefore as no surprise that Accenture's, 2005 e-Government study concludes that 'governments are making service investment decisions without a clear view of the outcomes they effect' (Accenture, 2005).

As a result of the above-mentioned motivations, the objective of this paper is to theoretically and empirically study factors leading to the adoption of e-Government services by business organizations.

The outcome of any study on e-Government adoption critically depends on the present state of e-Government maturity at the place where the study is conducted. The contextual setting for this study is Singapore. The city state is an ideal venue for such a study for three reasons. First, e-Government maturity is high; in fact, Singapore has ranked second in the world in terms of e-Government maturity. Second, Singapore's population is highly computer literate, which allows us to focus our study on the phenomenon of e-Government itself without confounding it with general issues of Internet and technology adoption.

Third, Singapore's government is comparably proactive in managing its economy, resulting in a high degree of interaction between the government and business organizations.

This paper contributes to research in a number of ways. First, it surfaces a research framework that will identify the factors important for encouraging adoption of e-Government services. It does so by viewing e-Government services as an innovation (distinct from other organizational or technical innovations) and attempting to determine the factors that affect the adoption of this innovation. This approach is in line with previous studies looking at adoption of electronic commerce (Kendall et al., 2001), Internet banking (Tan and Teo, 2000) and EDI (Premkumar et al., 1994). Second, our theoretical research framework integrates a number of different research streams: the literature on innovation diffusion, network externalities, social influence, and barriers to adoption. Finally, the dependent variable reflects the intended adoption times of a multitude of key e-Government services instead of just one service or a single overall measure. It is important to have multiple measures for the same construct to enable construct validation.

2. Theoretical background

Drawing from a study by Chwelos et al. (2001) on EDI adoption, this section discusses e-Government adoption influences from three perspectives: the technological, organizational, and inter-organizational perspective. The *technological* perspective deals with perceived characteristics of a particular technology; the *organizational* perspective focuses on organizational characteristics, whereas the *inter-organizational* perspective encompasses factors relating to the actions of other organizations (Chwelos et al., 2001). These three perspectives are believed to encompass the determinants of the adoption in the context of other emerging forms of inter-organizational systems (IOS). The introduction of e-Government services represents such a new form of IOS and the three perspectives named above can therefore be seen as capturing the critical determinants of a business organization's adoption decision.

Theory-wise, we will use Rogers' Diffusion of Innovation Theory to analyze technological adoption influences, whereas for organizational influences we will employ the literature on barriers to adoption. Additionally, the literatures on network externalities and social influence theory will both serve as a basis to capture inter-organizational factors. We will show how we intend to integrate these four theories into a unified framework explaining the adoption of e-Government services.

In Section 2.1, we will review the literature on the above-mentioned related streams of research to look at the factors that we consider important for adoption of e-Government services. We will detail these factors and explain why we consider them as important in this study.

2.1. The technological perspective

The Diffusion of Innovation Theory (Rogers, 1983) purports to describe the patterns of adoption, to explain the adoption mechanism, and to assist in predicting whether and how

a new invention will be successful. This perspective can be labeled as covering the 'technological' point of view according to Chwelos et al. (2001). It has potential application to information technology ideas, artifacts, and techniques, and has been used as the theoretical basis for a number of Information System (IS) research projects. Rogers (1995) notes that the five most important characteristics of innovations are (1) *relative advantage* (the degree to which an innovation is perceived to be better than the idea it supersedes), (2) *compatibility* (the degree to which an innovation is being consistent with existing values, past experiences and needs of potential adopters, (3) *complexity* (the degree to which an innovation is perceived as difficult to understand and use), (4) *trialability* (the degree to which an innovation may be experimented on a limited basis), and (5) *observability* (the degree to which the results of an innovation are visible to others).

A considerable body of work on IT acceptance and adoption has arisen as a consequence of Rogers' work (Brancheau, 1987; Brancheau and Wetherbe, 1990; Cooper and Zmud, 1990; Huff and Munro, 1985; Kwon and Zmud, 1987). Prior research includes the work of Brancheau and Wetherbe (1990), who conducted tests at the individual level at which innovation diffusion theory has been more thoroughly examined. Additionally, Huff and Munro (1985) found that a modified Rogers' model provided a good description of the IT assessment and adoption process. Although primarily focused on individual level adoption, Rogers' model appears to be applicable to IT implementations in organizations as well (Attewell, 1992; Brancheau and Wetherbe, 1990). A number of studies have applied diffusion theory in this context (Attewell, 1992; Brancheau and Wetherbe, 1990; Kwon and Zmud, 1987; Tornatzky and Klein, 1982). Newer innovations or technologies that have been studied in the organizational context include Electronic Data Interchange (EDI) and electronic commerce (EC). In the case of EDI, for instance, O'Callaghan et al. (1992) examine the adoption of EDI systems by independent insurance agents and find that relative advantage is a predictor of intent to adopt, as well as a differentiator between adopters and non-adopters. Likewise, Premkumar and Ramamurthy (1994) observe in a study of EDI adopters that relative advantage and compatibility are predictors of the extent of 'adaptation'. In their research adaptation is defined as the degree of EDI usage in purchase orders or invoices. Teo et al. (1995) use the Diffusion of Innovations Theory to predict the intention of banking organizations to adopt financial EDI in Singapore. Findings from their research show that both complexity and perceived risk are strong inhibitors of the intention to adopt EDI. In the case of EC, Kendall et al. (2001) surveyed Singapore Small and Medium enterprises (SMEs) to find out which of five attributes of Rogers' Diffusion of Innovation Theory will affect the receptivity of EC. Results indicate that only relative advantage, compatibility, and trialability appear to be significant.

The most commonly investigated EDI characteristics that promote the adoption of this innovation include relative advantage, compatibility, and trialability (Chwelos et al., 2001). These three attributes were found to be positively related to the adoption rate. However, relative advantage of EDI (defined as the degree to which an innovation is perceived to be better than the idea it supersedes) is the only variable that has been consistently identified as one of the most critical adoption factors across studies. It is considered as the most important factor for information technology growth in small and medium-sized enterprises (SME) (Iacovou et al., 1995). Therefore, this study will only probe into this factor and apply it to the context of e-Government services. Additionally,

e-Government services are available on the web using a web browser. The issues of technology compatibility and trialability are therefore not salient because as organizations will have web access as a result of the high Internet penetration rate. Moreover, the cost associated with trying out the e-Government services is low and the services can be assessed without additional hardware or software if there is access to the Internet. Thus, focusing only on relative advantage allows us to narrow our research scope while focusing on the most important factor.

Perceived benefits refer to the anticipated advantages that an innovation, in this case e-Government services, can provide to the organization (Chwelos et al., 2001). Perceived benefits from the adoption of e-Government services may serve as one of the main explanatory factors for the adoption. Receptivity towards e-Government services comes about when the new system is perceived as more beneficial than the paper-based system it supersedes, hence offering *relative advantage* to the agents of the organization. One of the main purposes behind the introduction of e-Government services is to facilitate firms to increase their Information Technology (IT) sophistication and to provide them with a higher level of convenience in their interaction with government. For example, firms can file Goods and Services Tax (GST) returns online, submit Central Provident Fund (CPF) contribution details to CPF board and check the validity status of employees' passes online. Like other EC technologies, e-Government services allow for faster transmission of data and greater data accuracy, resulting in improved clerical efficiency and managerial decision-making (Premkumar and Ramamurthy, 1995). Thus, we hypothesize that:

H1: The greater the perceived benefits for an organization, the more likely the organization will adopt e-Government services.

The technological perspective provided by the Diffusion of Innovation Theory however explains only a portion of the adoption decisions and is primarily based on individual-level adoption decisions on the ground of the individual agent's private incentives to adopt or not to adopt. The adoption is truly optional in the sense that the organization has a real opportunity to adopt or reject the idea, independent of other organizations. Another perspective views innovation as being diffused through particular channels, over time, and among the members of a social system. According to this view, innovation decisions may not only be *optional* (as they are viewed from the technological perspective), but also *collective* (where a decision is reached by consensus among the members of a system, as it is viewed from the organizational perspective), or *authority-based* (where a decision is imposed by another person or organization possessing requisite power, status, or technical expertise, as it is viewed from the inter-organizational perspective), (Rogers, 1983). The latter two perspectives warrant some closer investigation in the context of e-Government service adoption. We shall examine e-Government service adoption from the organizational perspective next.

2.2. The organizational perspective

From an organizational perspective, adoption of e-Government services may be affected by barriers to adoption. Organizational learning theories have identified a number

of barriers to adoption of new technologies (Chircu and Kauffman, 2000). These include the complexity of a technology, as well as the lack of 'facilitating conditions', which reflects the availability of resources needed to engage in a behavior, such as training, time, or money (Taylor and Todd, 1995).

Untrained users often find it difficult to adopt new technologies. However, both organizations and individuals have an absorptive capacity, which, when developed over time, helps to quickly internalize newly obtained knowledge and to use it effectively. A shortage of absorptive capacity will create knowledge barriers that hinder the adoption of new technologies, even where there is a willingness to adopt (Chircu and Kauffman, 2000). A firm's absorptive capacity depends, among others, on the strategic importance management gives to new technologies and on the management's profile (that is, the capabilities management itself has developed to understand and support technological change to achieve organizational objectives) (Paré and Raymond, 1991).

'Facilitating conditions', or the lack thereof, have been empirically shown to be significantly related to IT adoption decisions (Jiang et al., 2000). The degree to which management is willing and prepared to provide facilitating conditions to adopt e-Government services is termed 'management readiness' in this paper. Hence, we conjecture:

H2a: The higher management readiness, the more likely the organization will adopt e-Government services.

We will be examining this construct with respect to two aspects: The strategic importance management assigns to IT related decisions (labeled *strategic importance of IT*) and the degree to which management is enabled to take informed, IT related decisions (labeled *management profile*). Another important 'facilitating condition' for the adoption of new technologies concerns the importance management gives to cost reducing measures and hence their willingness to employ new technologies in order to achieve cost reductions. Consequently, we hypothesize that:

H2b: The higher the sensitivity to cost, the more likely the organization will adopt e-Government services.

2.3. The inter-organizational perspective

Several studies on electronic media use have been carried out to better understand the size of the audience needed for a new technology to be considered successful and the nature of collective action. Morris and Ogan (1996), for example, purported that electronic media will only become increasingly useful when the number of people who adopt them increases. Similarly, Rogers (1986) stated that 'the usefulness of a new communication system increases for all adopters with each additional adopter'.

Without doubt, many communications technologies, including the telephone and EDI, exhibit such direct network externalities. Economic theory has established that

these services will not be adopted to the optimal level, as the additional adopters cannot reap the full benefit of their adoption decision.

E-Government services, however, are not in this class of technologies. Other than the telephone, where the usefulness of the service to any subscriber critically depends on the presence of other subscribers on the network and in fact increases with their number, the usefulness of e-Government services to one organization per se does not depend on other organizations using the service.

Nevertheless do we suggest that e-Government service adoption poses a situation, where adopters are not able to reap the full benefits of their adoption decision and hence that the adoption decision is subject to a particular kind of externality. Our argument is based on the fact that a significant portion of the benefits created by e-Government services are obtained by the government itself in terms of efficiency gains. As government is a public organization, these efficiency gains will ultimately benefit all individuals and private organizations of a country, adopters as well as non-adopters. They will result not only in lower cost, but also in shorter administrative turn-around times for administrative processes and enquiries. However, many of these gains can only be realized if a 'critical mass' of organizations adopts the e-Government services, because only then will the traditional paper based system and processes become superfluous. The issue arising is therefore an incentive problem: Enough organizations need to be convinced to adopt in order for the universally beneficial government efficiency to set in. However, once this critical mass is reached, all organizations benefit, including the non-adopters[5]. As in the case of the standard direct network externality, the above-described indirect externality will negatively impact the overall adoption of e-Government services and deprive early adopters of reaping the full benefits of their adoption decision. In order to overcome this problem and ensure an efficient level of e-Government adoption, both Governments and industry organizations are therefore likely to exert some form of pressure or additional incentives on businesses to adopt electronic services.

In Singapore, the context of this study, it is believed that a few governmental agencies are highly influential, and thus have a strong central authority influencing technology decisions (Teo et al., 2000). Singapore firms often favor organizational choices that are consistent with views espoused by government, government-related, and/or collective associations. Including this aspect into the research model is reflecting the specific contextual setting of this study.

This study, therefore, includes the effect of *external pressure*, such as government pressure and industry pressure on the adoption decision. *Government pressure* relates to

[5] In the sociology literature, this phenomenon has been described by Collective Action Theory. Based on work by Olsen (1965), this theory deals with the difficulty of mobilizing collective action in pursuit of collective, non-exclusive goods. Critical Mass Theory, an extension of collective action theory, argues that a user's decision to participate in a collective action is based on his or her perceptions of the actions of the rest of the members. The number of people who have already participated, the degree to which others has contributed, and the identity of the participants influence the user's decisions (Bouchard, 1993). Both theories suggest that collective action problems are exacerbated by large group size and by group asymmetry (Sandler 1992, Oliver et al., 1985). On the other hand, collective action failures caused by inter-organizational influences may be reduced or overcome through measures such as selective private incentives, institutional design, as well as government intervention (Sandler 1992).

the efforts of the governmental agencies to encourage e-Government services adoption. *Industry pressure* relates to the efforts of industry associations or lobby groups to encourage adoption (Chwelos et al., 2001). Finally, a third external pressure may arise when organizations presume that competitors may gain comparative advantages as a result of using e-Government services. Hence, we also considered the impact of *competitive pressure* in our study, referring to the ability to maintain or increase competitiveness within the industry through the use of e-Government services. In summary, we posit that:

H3a: The greater the external pressure faced by an organization, the more likely the organization will adopt e-Government services.

A complementary view on the inter-organizational level is provided by social influence Theory. According to Rhoads (1997), '*influence* investigates the causes of human change, whether that change is a behavior, an attitude, or a belief'. *Social influence* is said to be employed by an agent or practitioner upon a target (Rhoads, 1997). By considering the target as the business organization and the agent as the public, the definition of social influences in this study focuses on the public's perception of the organization's standing, which in turn will affect its actions.

Social influence comes in when organizations that take an initiative in adopting e-Government services are viewed more favorably by the public or by other organizations. An organization that adopts information technology (IT) could possibly portray itself as being IT savvy in its industry due to its receptivity towards innovation. In our context, firms may try to portray an IT-savvy image by responding to the Singapore Government's ICT21 Master Plan for the Net Economy and Communication Technologies Sector. More importantly, e-Government services are often not only one-to-one transactions between a specific business and the Government, but may entail multiple organizations. For example, the process of importing goods into a country will typically involve a three-way exchange of information between the importer of the goods, the shipping company, and the government. To the extent that e-Government adoption leads to greater efficiency in handling such administrative processes for all involved parties, organizations will tend to be more willing to adopt the use of e-Government services in order to present a better image to the public and to current and potential business partners, as well as to potential investors. Hence, we conjecture that:

H3b: The greater the social influence faced by an organization, the more likely the organization will adopt e-Government services.

The above discussions have led to the formulation of our research model, which is summarized in Fig. 1.

Perceived benefits, management readiness, sensitivity to cost, social influences, and external pressure are first-order variables in our study. Management readiness comprises of two aspects: strategic importance of IT and management profile. These two aspects were analyzed as second-order variables in our study. In sum, our research model reflects the three perspectives of the Chwelos et al. (2001) study's model adapted for the context of this study.

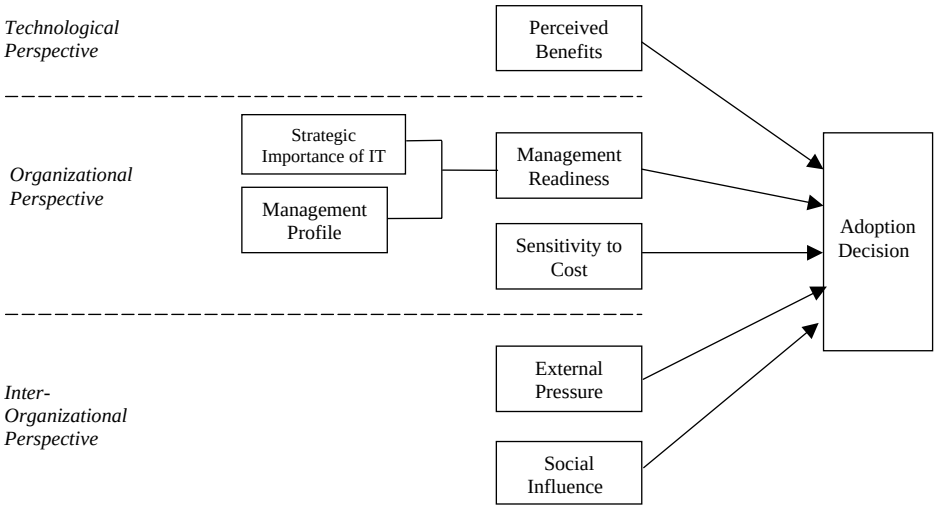

Fig. 1. Summary of research model.

3. Research methodology

The primary mode of data collection is through the use of surveys. Respondents were not cued as to what variables the items are measuring so as to improve response reliability. The study context, operationalization of research constructs, and statistical approach are described below.

3.1. Study context and sample

The research was targeted at business organizations in Singapore that were either solely Internet adopters or were both Internet and e-Government services adopters. Our survey population consists of companies in the 'Singapore 1000' listing (DP Information Network, 2001), and thereby excludes from our sample the numerous very small businesses in Singapore, which in their adoption behavior may more closely resemble private individuals than larger business organizations.

Each survey was carefully assessed for content validity and unambiguous instructions before the surveys were sent out. After analyzing the responses, several minor revisions were made to the questionnaires. These revisions included clarifying terms and including bridges and instructions to clarify the intents.

We contacted the survey in three rounds, randomly picking about one-third of the Singapore 1000 companies for each round. Companies surveyed in the previous round(s) are excluded from being surveyed again[6]. At the end of the three rounds, all 1000

[6] Some of the respondents returned their survey choosing to remain anonymous about their organizations' name. As such, we were not able to find out exactly which firms responded to the survey. Thus, contacting the same firm more than once could have lead to some firms responding twice or more and thus being over-weighted in our survey. Therefore, we decided to contact each firm only once in this study.

companies had been contacted for the survey. For the first round, pre-screening calls were made to 353 randomly selected organizations (from the Singapore 1000 companies) to determine whether they were Internet or e-Government services adopters. A similar screening question was also included in the survey to ensure that responses from e-Government services adopters could correctly be distinguishable from non-e-Government services adopters. Two hundred and six organizations could eventually be contacted and agreed to participate in the survey, out of which 46 completed the survey. In the second round of the survey, conducted a month later after the first round, an additional 300 potential respondents were randomly selected from the remaining population of the Singapore 1000 companies mentioned earlier, out of which 31 companies responded. In the third round, conducted one month later, the remaining 347 potential respondents from the remaining population were sent the surveys and we received 51 responses. Eventually, 128 responses were deemed usable for analysis, giving a response rate of 15.0%. All surveys were sent by post, electronic mail, or by fax.

3.2. Operationalization of research variables

The operationalization of research variables can be obtained from Table 1. Most of the items were adapted from Chwelos et al. (2000, 2001) and Cheung et al. (2000). Several items were self-developed. All items were measured on Likert scales.

Perceived benefits was measured by one item (Item 1), which asked for the importance of certain benefits to the organizations' adoption decision. Thirteen benefits were listed, such as improved accuracy and filing applications online. This item was adapted from Chwelos et al. (2001). However, more benefits relevant to the e-Government context were added. *External pressure* was measured using five items (Items 2–6), covering pressure imposed by competitors, industry sources, and governmental agencies. *Social influences* was measured by two self-developed items and one adapted question (Items 7 and 9). Social influences can be described as the perception of the public, of prospective investors, and of other related organizations as to the attractiveness of a firm that adopts e-Government services. Items used by Kats and Lazarsfeld (1955) were not relevant to our context.

We measure *sensitivity to cost* using a three item scale (Items 10a to 10c), adapted from Chwelos et al. (2001) and Cheung et al. (2000). It was operationalized as the importance of IT in fulfilling the firm's objectives, including operational objectives (such as personnel reduction, cost reduction, and productivity improvement from normal operational activities). The strategic importance of IT measure (Items 10d–g) is adapted from the strategic objectives of the scale mentioned above (enhancement in the quality of access to information, decision making, competitiveness, and service to customers). The operationalization of *management profile* covers the type of activities and training that management personnel has taken part in (Items 11a–d). The responses are aggregated to form one single response (e.g. if a respondent answered 'yes' to all four questions, then the aggregated score is '4', but if s/he answered 'no' to all four questions, then the score is '0').

The 'adoption decision' variable measures usage of e-Government services using multiple questions (Item 12). Rather than probing the respondents for the use of any specific kind of service, we asked them to specify their use of a number of service

Table 1
Operationalization of research variables

Variable	Items	Source[a]
Perceived benefits	(1) Please rate the importance of achieving each of the following benefits of using e-Government services in terms of your organization's decision whether or not to adopt e-Government services	
	(a) Paper reduction	Chw
	(b) Equivalent success with other organizations in the industry	Self-d
	(c) Reduced communication cost	Chw
	(d) Improved accuracy	Chw
	(e) Enhanced ability to compete	Chw
	(f) Availability of forms online	Self-d
	(g) Filing applications online	Self-d
	(h) Tendering/bidding projects/jobs online	Self-d
	(i) Submit CPF contribution details**	Self-d
	(j) Check validity status of various passes/permits online**	Self-d
	(k) Availability of answers to queries online	Self-d
	(l) Faster approval of applications online	Self-d
	(m) Reduced errors in filling application forms	Chw
	Items measured on a seven point scale from 1 = 'not at all important' to 7 = 'extremely important'	
External pressure	Please indicate the appropriate response to the following statements:	
	(2) Please rate the pressure placed on your organization to adopt the use of e-Government services by your competitors	Chw
	(3) Please rate the pressure placed on your organization to adopt the use of e-Government services by industry sources (such as trade associations)	Chw
	(4) Please rate the pressure placed on your organization to adopt the use of e-Government services by various governmental agencies	Chw
	Items (2) to (4) measured on a seven point scale from 1 = 'no pressure at all' to 7 = 'extreme pressure'	
	(5) How often does your organization receive information regarding the adoption of e-Government services from sources outside your organization (such as industry associations, professional associations, or trade newsletters)?	Chw
	(6) How often does your organization receive information regarding the adoption of e-Government services from various governmental agencies?	Chw
	Items (5) and (6) measured on a seven point scale from 1 = 'never' to 7 = 'very often'	
Social influences	Please indicate the appropriate response to the following statements	
	(7) In the Internet-savvy age, firms that adopt e-Government services are perceived to be more attractive to prospective investors	Self-d
	(8) Society's perception towards my organization will influence the adoption of e-Government services in my organization	Self-d
	(9) In my industry, the adoption of e-Government services is helpful in allowing an organization to remain competitive.	Chw
	Item (7) to (9) are measured on a seven point scale from 1 = 'strongly disagree' to 7 = 'strongly agree'	
Sensitivity to cost factors	Please indicate the appropriate response to the following statements	
	(10) Information technology can be used for a number of objectives. To what extent is information technology important for the fulfillment of the following objectives in your organization?	Chw, Cheu
	(a) Personnel reduction	
	(b) Operational costs reduction	
	(c)Productivity improvements**	

Table 1 (*continued*)

Variable	Items	Source[a]
Strategic importance of IT	(d) Improved access to information (e) Improved quality of decision making (f) Improved competitiveness (g) Improved service to customers Items 10a to 10 g are measured on a seven point scale from 1 = 'not at all important' to 7 = 'extremely important'	Chw, Cheu
Management profile (recoded)	(11) My organization's management personnel has taken part in the following activities: (a) Attended computer classes relating to the Internet (b) Used Internet services at home** (c) Use Internet services at work** (d) Have formal qualifications in the use and operations of a computer relating to the Internet Items 11a to 11d are measured on a scale of (0) No and (1) Yes. This scale is translated to a single item scale that aggregates all 4 parts and gives a single score. E.g. someone who answers 'Yes' to all 4 parts of this question will get a score of '4'	Self-d
Adoption decision	(12) Is your organization using the e-Government services for the following activities? If not, when do you intend to use it? (a) Ask questions online (b) Download forms (c) File applications online (d) Check validity status (e) Tender/bidding/handling of transactions online 1 = 'already using it', 2 = 'in ≤ 1 yrs', 3 = 'in 1 < yrs ≤ 3', 4 = ' in 3 < yrs ≤ 5', 5 = 'in 5 < yrs < 10' and 6 = ' > 10 yrs' (items are reverse coded)	Self-d

**Items marked with two asterisks were excluded from further analysis after the factor analysis.

[a] Chw Chwelos et al. (2001); Cheu Cheung et al., 2000; self-d self-developed.

categories that reflect different degrees of sophistication and interactivity[7]. The services categories include asking questions online, downloading forms online, filing applications online, checking validity status of various passes or permits online, and tendering, bidding or handling of transactions online. A firm that uses any of these services was considered to be an e-Government services adopter.

3.3. Statistical approach

This paper uses a component-based structural equation modeling technique, the partial-least-squares (PLS) method. PLS is especially suitable for exploratory studies and model

[7] These categories represent e-Government services that involve pure information dissemination, two-way communication, or transactions. A similar categorization is employed by Hiller and Bélanger (Hiller and Bélanger, 2001) in their discussion of e-Government stages. Their study includes two additional stages, namely 'vertical and horizontal integration' and 'political participation'. Vertical and horizontal integration does not represent a specific type of e-Government service, but rather a way of organizing such services. We therefore omitted this aspect in our study, Also, since our study focuses on G2B services, we refrained from including services related to political participation, which are mostly G2C driven.

testing (Chin, 1998b; Gefen et al., 2000). Existing innovation diffusion studies have yet to examine the adoption of e-Government services, which is a relatively new development. PLS is a suitable analytical tool for a paper that is among the first to apply theoretical rationale from four different research streams to the adoption of e-Government services. In addition, with minimal requirements on sample size and residual distributions (Chin, 1998a,b; Gefen et al., 2000), PLS is also an apt analysis procedure for this study that uses 128 responses. Other techniques such as LISREL require a sample size of 200 and above. PLS is also an efficient and yet in-depth analysis method that assesses the measurement and structural models together. Hence it is suitable for complex models (Gefen et al., 2000). For these reasons, PLS is adopted here.

4. Data analysis and results

4.1. General profile and summary

Major industries in Singapore include trading, architecture, engineering, education, banking and finance, insurance, manufacturing, pharmaceutical or biotechnology, printing and publishing, services, transportation, travel, tourism and hotel (Harrison et al., 1997). The random sample of firms that eventually participated in the survey included firms of all these industries. However, large proportions are from the manufacturing, trading, and services sector consisting of 38 (29.7%), 25 (19.5%) and 15 (11.7%) organizations, respectively.

Our sample is composed of 52.3% large organizations (with more than 100 employees) and 39.9% medium sized organizations (21–99 employees). In 61% of the responding organization IS budgets do not form a significant portion of the operating budget ($<6\%$). More than half of our respondents (67.2%) had annual revenues of more than S$1 m.

This study also conducted an analysis of usage patterns among adopters of e-Government services. There is no particular distinct e-Government service that is prominent in organizations that adopt the use of e-Government services. However, it is noted that more than half of the respondents downloaded forms online and file applications online. Less than half of the organizations make use of the e-Government services to ask questions online, to check validity status or passes or permits online and to tender, bid or handle transactions online.

Of all the respondents, 46 came from organizations that do not make any use of e-Government services.

4.2. Measurement, structural model, and results

Constructs using multiple reflective questions[8] had to be assessed for convergent and discriminant validity to establish the strength of the measurement model[9] (Hair et al.,

[8] In this study, both first-order and second-order factors (strategic importance of IT and management profile) are reflective in nature.

[9] All scores are standardized to z-scores before they are used as inputs to the analysis.

1998). *Convergent validity* of a construct can be established if two or more attempts to measure the construct are consistent with one another (Cook and Campbell, 1979). Common tests used to assess convergent validity include a check for item loading, internal consistencies of constructs, Cronbach's alpha, and average variance extracted by constructs. Item loadings and internal consistencies greater than 0.70 are generally considered acceptable (Fornell and Larcker, 1981). Hair et al. (1998) proposed 0.5 as an indication of adequate reliability. Fornell and Larcker (1981) suggested 0.5 as an indication of adequate variance extracted.

From Table 1, two items from the Perceived Benefit and one item from the sensitivity to cost constructs were dropped from the analysis due to poor item loading. Table 1 marked the items that are dropped due to poor item loadings; the remaining items are retained for further analysis. Subsequent to that, all variables were measured successfully (see Table 2 for descriptive statistics). Item loadings and internal consistencies of 0.7 and above are accepted (Fornell and Larcker, 1981). Seven constructs, perceived benefits, external pressure, social influences, sensitivity to cost, strategic importance of IT, adoption decision and management readiness (a second-order variable) have multiple measures that loaded well. Only one item for perceived benefits (namely, the item 'tendering/bidding projects/jobs online') loaded below the 0.70 threshold with a 0.67 loading. We decided to keep this item as it is close to the threshold and it describes a unique and integral part of perceived benefit for e-Government services. Item loadings of questions that remained are high; they range from 0.73 to 0.96.

Internal consistencies of all research variables ranged from 0.74 to 0.94, well above the recommended threshold of 0.7 (Fornell and Larcker, 1981). Average variance extracted by constructs, as shown in the bolded diagonal of Table 4, are above the recommended 0.50 level (Fornell and Larcker, 1981). Cronbach's alphas are generally above the 0.5 level (Hair et al., 1998) (ranges from 0.83 to 0.94) with one exception. The Cronbach alpha for the second-order variable, management readiness, is 0.43. We decided to keep this second-order construct, as the other test results for convergent validity, item loading, internal consistency, and average variance extracted for this construct are high. Additionally, Gregory (2000) mentioned that many standard tests with reliabilities as low as 0.70 prove to be very useful and tests with reliabilities lower than that can be useful in research. Finally, Nunnally and Bernstein (1994) pointed out that instruments with modest reliability are acceptable in early stages of predictive or construct validation research. Nonetheless, results for this construct should be interpreted with caution.

Discriminant validity occurs when measures of each construct are distinct from one another (Campbell and Fiske, 1959). In this study, we first conducted a factor analysis to ensure that questions are loaded more highly on their intended construct than other constructs (see Table 3). Additionally, we examined the average variance extracted by each construct to ensure that it exceeds the shared variance between that construct and other constructs (see Table 4), or, in other words, that each question correlated more highly with other questions measuring the same intended construct than with other questions measuring other constructs (Fornell and Larcker, 1981). Results indicated that the factors loaded as intended and the square root of the AVEs were all greater than

Table 2
Convergent validity tests

Research variables	Item loadings	Internal consistency	Alpha	Research variables	Item loadings	Internal consistency	Alpha
Perceived Benefits (PB)				Sensitivty to Cost (CF)			
PB1a	0.77	0.94	0.94	CF10a	0.96	0.74	0.88
PB1b	0.73			CF10b	0.80		
PB1c	0.79			Strategic Importance IT (IT)			
PB1d	0.79			IT10d	0.90	0.87	0.83
PB1e	0.75			IT10e	0.75		
PB1f	0.81			IT10f	0.78		
PB1 g	0.74			IT10 g	0.74		
PB1 h	0.67			Adoption Decision (AD)			
PB1k	0.83			AD12a	0.87		
PB1 l	0.83			AD12b	0.90		
PB1m	0.81			AD12c	0.90		
External Pressure (EP)				AD12d	0.91		
EP2	0.80	0.91	0.87	AD12e	0.88		
EP3	0.80			2nd Order Factor-Management Readiness (MR)			
EP4	0.76						
EP5	0.83			MR10d-g (Strategic Importance of IT)	0.79	0.77	0.43
EP6	0.86						
Social Influence (SI)							
SI7	0.86	0.89	0.84	MR11a-d (Management profile)[a]	0.80		
SI8	0.88						
SI9	0.83						

[a] Single-item measure.

the corresponding inter-variable correlations. Hence, all constructs in this study have discriminant validity.

The PLS structural model in Fig. 2 showed *H1*, *H3a* and *H3b* to be significant.[10] *H2a* and *H2b* were not significant. R^2 was 33.52%.

[10] The corresponding t-values are calculated using the jackknifing technique.

Table 3
Results of factor analysis

Question	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
PB1a	**0.805**	0.053	0.049	0.055	0.113	0.179
PB1b	**0.733**	0.065	0.096	−0.020	0.229	0.191
PB1c	**0.758**	0.115	0.111	0.153	0.100	−0.023
PB1d	**0.805**	0.101	0.190	0.133	0.025	−0.003
PB1e	**0.721**	0.182	0.115	0.052	0.112	0.085
PB1f	**0.744**	0.179	0.119	0.386	−0.024	0.094
PB1 g	**0.659**	0.208	0.102	0.339	−0.071	0.243
PB1 h	**0.550**	0.209	0.125	0.165	0.317	−0.058
PB1k	**0.773**	0.165	0.144	0.152	0.185	−0.009
PB1 l	**0.800**	0.185	0.144	0.191	0.016	−0.109
PB1m	**0.787**	0.137	0.139	0.130	0.173	−0.105
EP2	0.187	0.189	**0.765**	−0.144	0.137	0.170
EP3	0.141	0.141	**0.838**	−0.001	0.147	0.075
EP4	0.284	0.232	**0.776**	0.073	0.096	−0.120
EP5	0.180	0.110	**0.684**	0.241	0.322	−0.070
EP6	0.086	0.242	**0.685**	0.225	0.167	−0.172
SI7	0.151	0.178	0.272	0.037	**0.797**	0.097
SI8	0.184	0.196	0.174	−0.022	**0.826**	−0.144
SI9	0.289	0.196	0.292	0.107	**0.721**	−0.069
CF10a	0.101	−0.129	−0.065	0.077	−0.090	**0.856**
CF10b	0.129	−0.083	0.026	0.479	0.004	**0.735**
IT10d	0.240	0.126	0.094	**0.692**	0.170	−0.198
IT10e	0.345	0.012	−0.013	**0.727**	0.008	0.120
IT10f	0.148	0.054	0.090	**0.796**	0.050	0.355
IT10 g	0.151	0.008	0.074	**0.838**	−0.041	0.121
AD12a	0.188	**0.854**	0.185	0.061	0.075	0.028
AD12b	0.153	**0.832**	0.144	0.022	0.198	−0.214
AD12c	0.143	**0.860**	0.181	0.119	0.097	−0.028
AD12d	0.209	**0.834**	0.174	−0.030	0.225	−0.113
AD12e	0.298	**0.818**	0.182	0.040	0.078	0.053

Table 4
Means, standard deviations, inter-correlations and AVEs of variables[a]

	Mean	Std. deviation	1	2	3	4	5	6
PB	4.81	1.08	**0.78**					
EP	3.30	1.17	0.44	**0.81**				
SI	4.02	1.21	0.43	0.53	**0.86**			
CF	4.94	1.30	0.15	−0.08	−0.11	**0.88**		
MR	2.97	1.03	0.43	0.30	0.25	0.17	**0.80**	
AD	5.08	1.05	0.43	0.47	0.44	−0.15	0.27	**0.89**

[a] The diagonal elements in bold are the average variance extracted (AVE) which is the square root of the variance shared between the constructs and their measures. AVE = $(\Sigma\lambda_i^2)/[(\Sigma\lambda_i^2) + (1 - \Sigma\lambda_i^2)]$. Off diagonal elements are correlations among the variables. The diagonals should be larger than any other corresponding row or column entry in order to support discriminant validity.

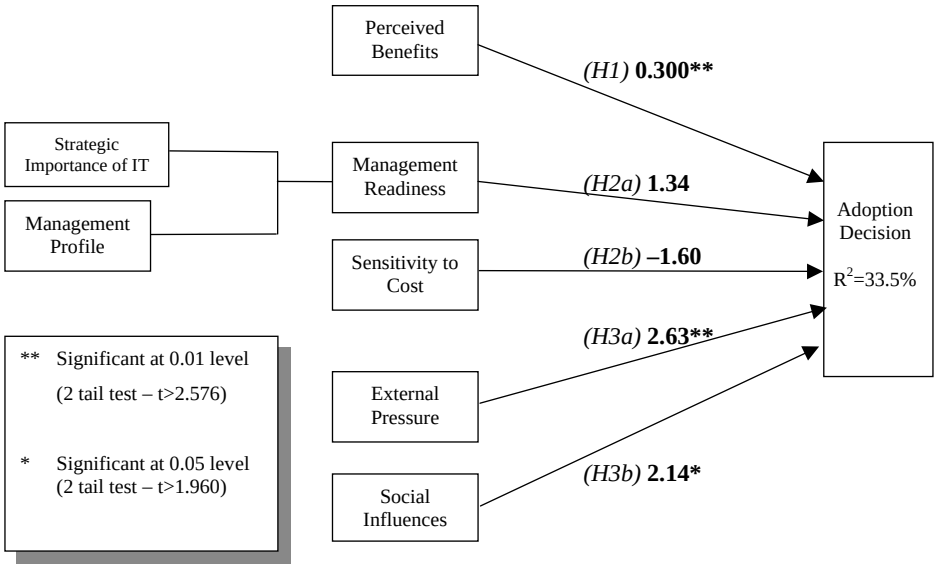

Fig. 2. Research model with results of PLS analysis.

5. Discussion

The overall explanatory power of our research model was high; a R^2 of 33.52% was obtained. Perceived benefits, external pressure and social influence were found to be significant in terms of being related to the adoption decision, whilst management readiness and sensitivity to cost were found to be not significant.

From the *technological perspective*, perceived benefits was found to be empirically significant, which is in line with classical innovation studies, where relative advantage was consistently found to be a significant factor (Chwelos et al., 2001; Iacovou et al., 1995). This result is also in line with previous qualitative studies that emphasized the benefits e-Government would bring to organizations, including greater transparency, cost reductions, or the availability of new type of services. Our findings are encouraging, as they support the governments' motives for introducing e-Government services and provide a good reason for increasing the provision of additional and improved e-Government services.

Out of all the factors related to the *organizational perspective* none was found to be significant. Management readiness was positive and insignificant, whereas sensitivity to cost was negative and insignificant. This appears to contradict earlier papers researching on the relationship between facilitating conditions and the adoption decision (Jiang et al., 2000). E-Government services, while certainly constituting an innovation, do not appear to face the typical barriers to adoption, such as lack of training or funds, as they were explored in this study.

A possible explanation for these results may be that they are simply an artifact of the setting in which this study was conducted. Singapore's e-Government services are regarded as highly developed precisely for the reason that they are easy to use and can be

handled with a common-sense approach. It is not surprising, therefore, that companies perceive the barriers to adoption as low. Secondly, e-Government services are web-based and hence employ a commonly known user-interface. The IT related cost and effort of adoption are therefore relatively low when compared with other innovations, such as EDI or EC. When regarded as an IT innovation, e-Government services indeed appear to face low barriers to adoption or none at all.

From an *inter-organizational perspective*, the relationships between external pressure and social influence with the dependent variable were both significant. These results are in line with studies on EDI adoption and network effects (Bouchard, 1993; Chwelos et al., 2001). Yet, they are remarkable, because in the case of e-Government the network effects are realized in a rather indirect fashion: A large portion of the benefit of attracting a critical mass of adopters is at first instance realized by the government and will therefore benefit organizations mainly through lower processing times in the government bureaucracy. Organizations may not always be certain about the magnitude of benefits, and about when, if at all, those benefits will be passed on to them. Nevertheless this collective benefit appears to result in a pressure on organizations to adopt.

Finally, social influences were also significant. The adoption of e-Government services contributes to the image of being IT-savvy, which is important to the adoption decision. This result comes as no surprise in a society where government has a significant influence on public life and public perception and where organizations frequently interact with government.

6. Limitations

There are several limitations in this research. First, the low response rate of 15% may affect the generalization of our findings to all top 1000 business organizations in Singapore and curtails the depth of statistical analysis that is possible. Generally, surveys targeting organization representatives tend to have a lower response rate as compared to those targeting individuals (Baruch, 1999). Additionally, organizational surveys conducted in Singapore generally suffer from low response rate (Tan and Tan, 2002)[11]. Efforts were made to boost the participation rate as much as possible by persuading companies to take part before surveys were sent out.

Second, in terms of generalizability to other countries' e-Government services, results of this study can be expected to apply in general to countries with large government sectors. They will have to be interpreted with caution for countries that are very different in their business environment, business culture, and political system. Additionally, there is inadequate empirical research to support meaningful generalization across different

[11] For example, Dulaimi et al. (2002)'s response rate for their survey was 11.22%. Kendall et al. (2001)'s response rate for their study on SMEs in Singapore was 14.5%. Given the relatively small number of large companies in Singapore, these companies generally receive many more requests for completing surveys per year than they can handle. Thus, many request for completion of surveys are left uncompleted by these organizations. Hindle and Lee (2002) noted on getting a single digit response rate for their survey: 'This low response rate conveys some measure of the difficulties involved in conducting surveys in Singapore'.

countries in terms of e-Government adoption. To facilitate comparisons across different countries, more research is needed, given the scarcity of research in this area.

Finally, our sample is also chosen from different industries. Due to the low response rate, it was not feasible to conduct an analysis of the adoption decision according by industry. As such, it is important to note that some industries are more volatile than others or tend to have a higher need for the use of the e-Government services in their business activities. For future studies, stratified random sampling by industry could be used to better examine the factors affecting e-Government service adoption.

7. Future research, implications, and conclusions

To extend this study, future studies can investigate the adoption decision according to industries. Organizations from different industries face different operating conditions and may possess different requirements. For example, business conditions in a manufacturing industry are different from that in a pharmaceutical industry. Such findings may be invaluable in delivering more effective and targeted administrative services. As the survey respondents used in this study are companies from a variety of industries, we could not provide a more detailed industry focus. Also, having a model that is static in nature and a single-country context, we were not able to make inferences about optimal growth strategies for e-Government services. Future research may attempt to provide insights along this dimension.

The adoption decision can also be analyzed from the perspective of individuals and households. The Singapore government had hoped to deliver customer-centric administrative services, with customers being both businesses and individuals. Future studies can examine whether differences in factors influencing adoption decisions exist between businesses and individuals. Significant differences may imply markedly different service delivery and facilities for both groups of users.

Finally, with web-technology having emerged as the ubiquitous standard for user-interfaces of electronic services and with employees becoming increasingly IT-savvy, adoption studies of IT services could start looking beyond the classical aspects of intra-organizational barriers to adoption, such as lack of training and funds. A valuable extension of this study could therefore be to view *intra-organizational process changes* as part of the adoption process, since the streamlining of processes is needed to realize cost and productivity benefits associated with using e-Government services. Barriers to adoption may turn out to be significant when organizations try to implement such process changes, rather than in the plain (technological) adoption decision. However, such an extension would require a more in-depth research methodology, such as a multiple-case-study approach.

There are also several implications of this study for research and practice. First, in countries where e-Government services exhibit a high degree of maturity, the question of how to further increase the usage of e-Government services may not be so much an issue of (intra-organizational) education and training, but rather one of public awareness of the direct and indirect benefits. Organizations do respond to external influences and make use of non-mandatory e-Government services, even when the benefits may not be direct

and immediate. Financial incentives for using e-Government services may help to reallocate some of the efficiency gains achieved by the government directly back to the adopters of e-Government services and thus provide an additional incentive to adopt them.

Second, the significance of perceived benefits indicates the importance of managing e-Government services effectively to increase their adoption. Efforts to update online notices regularly, the use of sophisticated web site security tools, and prominent display of quality and Net-trust certifications would greatly enhance the confidence and awareness of e-Government services. Greater publicity regarding the usefulness of these services and their resulting savings would also introduce greater awareness and improve their perceived benefits in the eyes of the public. The portrayal of an up-to-date, effective and secure online public administration may also encourage more companies to make queries, download forms, file returns and even tender for government projects online, leading to significant cost savings and efficiency gains for both the government and participating companies.

Finally, to conclude, we argue that our research model, which integrates four theoretical research streams (the literature on innovation diffusion, network externalities, social influence, and barriers to adoption), can serve as a starting point for other research looking at the adoption decisions of technologies. In this study, the theoretical bases of innovation diffusion, network externalities and social influence have been found to be instructive towards our understanding of the adoption decision of e-Government services. We believe that they can be applied towards the adoption of other technologies (delivered via the World Wide Web or otherwise) as well. In terms of barriers to adoption, even though factors related to the organizational perspective were found to be insignificant in this study, we contend that it can still be a valuable theory for understanding successful technology adoption. Barriers to adoption may be important to the organizational perspective if the technology being investigated faces high barriers to adoption such as the lack of training or funds.

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