Exploring success factors for Taiwan's government electronic tendering system: behavioral perspectives from end users

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Abstract

This study explores the key success factors of the electronic tendering system (ETS) in Taiwan through the behavioral perspectives of the end users. Based on the Theory of Planned Behavior (TPB), the study proposes an integrated model for the empirical examination of the users' intention and behavior for using the ETS. The results show that users' overall satisfaction, specifically explained by perceived usefulness and information accuracy of the ETS, most significantly affect their intention to adopt the ETS. In addition, increasing the relevant knowledge and skill of the users effectively enhance their intention and the actual usage as well. Comparatively, influences from the users' coworkers and supervisors exercise less significant impact on the adoption if the ETS.

Keywords: Electronic government; Electronic procurement (e-procurement); Electronic tendering system; Theory of planned behavior; End user satisfaction

In 1997, the national government of Taiwan announced its future actions for reinventing its administration in the information age, including National Information Infrastructure (NII) and Electronic Government (EG) programs. The Electronic Government program has focused on three types of online governmental services, including government to government (intra-agencies, G2G), government to citizens (G2C), and government to business (G2B). Among them, electronic procurement (e-procurement) has been one of the representative G2B actions for digitizing the procurement procedure in governmental agencies where inefficiency and even corruption have been underlying problems.

Driven by the Public Construction Commission (PCC) of Taiwan's central government, a series of Internet-based electronic procurement systems have been designed and implemented since 2000.[1] The complete electronic procurement system is composed of four subsystems, that is, Government Procurement Information System, Common Supply Contract System, Suppliers Catalog, Inquiry, and Quotation System, and Electronic Tendering System (ETS). Each subsystem is responsible for different stages of the procurement procedures. The Electronic Tendering System supports the tasks of downloading and uploading electronic tender documents via the Internet. It also provides a unified and updated source about potential suppliers for various governmental agencies, as well as maintains the most updated procurement information and requirement across governmental agencies for these potential suppliers. Therefore, the transparent procurement procedure powered by the Electronic Tendering System has been regarded as one of the most important merits embedded in the digital government. As of December 2002, the Public Construction Commission statistical reports show that over 100,000 public agencies have utilized the Electronic Tendering System to upload the procurement documents. Over 200,000 firms have attempted to supply construction projects, goods, and services by downloading the documents via

the Electronic Tendering System.

From a pragmatic point of view, understanding the determinants of using information technology (IT) should ensure an effective deployment of information technology resources in an organization. Thus, evaluating technology acceptance, especially from the behavioral perspectives of the ETS end users, has been critical for its continuing promotion and strategic revision aside from the existing statistics reported by Public Construction Commission above. Among the existing research on information technology acceptance from the attitude or behavior perspectives, intention-based models such as Theory of Planned Behavior (TPB)[2] have gained the attention from many researchers and are widely employed to provide an understanding of the determinant of technology usage.[3]

This article, accordingly, intends to propose an integrated model to explain and evaluate the end users' behavior and attitude of the ETS usage;

- empirically examine the appropriateness of the proposed model;
- develop diagnostic tools to predict the ETS acceptance and facilitate design changes; and
- conclude with policy recommendations for promoting the ETS and the online governmental services in general.

In the following sections, we firstly review the literature of information technology usage and propose a model for evaluating the ETS. The research design will then be introduced, followed by empirical results, policy implications, and concluding remarks.

1. A behavioral model for evaluating the ETS adoption

Theory of Planned Behavior provides comprehensive understanding of usage behaviors and intentions and serves our research as the theoretical background. A central proposition of Theory of Planned Behavior, which is closely related to Technology Acceptance Model (TAM)[4] and has received considerable empirical support,[5] in the context of information technology usage is that the users' actual behavior (B) is determined by their behavioral intention (BI) to use the technology. That is, people tend to better adopt a new IT when they have more intention to use it. Equally important is another proposition about the so-called perceived behavioral control (PBC) that the actual usage behavior is also affected by whether the users have perceived sufficient control of capability and resources necessary to adopt the IT. The preceding influences from behavioral intention and perceived behavioral control to the end users' actual IT usage compose the right-hand part of our proposed model in Fig. 1.

The behavioral intention for IT usage is then jointly determined by three conceptually distinct constructs based on Theory of Planned Behavior: attitude (AT) toward using the IT, subjective norm (SN), and perceived behavioral control (PBC). The case of adopting the ETS shows that the users' intention to adopt ETS is affected, as in Fig. 1, by the following: (1) their attitude toward ETS, which reflects their overall evaluation or satisfaction; (2) the subjective norm about ETS, which reflects their perceptions of social pressure affecting the IT usage, such as pressures from their supervisors and colleagues; and (3) the perceived behavioral control, which as theorized above reflects the beliefs regarding their control over the factors that may facilitate or impede the IT usage.

Our integrated model is further expanded to include the constructs and relations that might be important in IT usage. Firstly, we take a decomposition approach to belief structures, which are

treated as monolithic in the traditional Theory of Planned Behavior model.[6] As indicated in Fig. 1, the users' attitude is determined jointly by their perceived usefulness (U) and perceived ease of use (EOU) of the ETS,[7] as well as by their perceived accuracy (AC) of the information provided by the ETS.[8] Secondly, the users' perceived behavioral control, according to the literature,[9] is divided into (1) self-efficacy (SE), which reflects the users' confidence in their knowledge and ability of mastering the computing technology required by the ETS, and (2) facilitating conditions (FC), which refers to the availability of the resources such as computers and the Internet access necessary to perform the ETS. Our proposed model is summarized in Fig. 1 based on the previous decomposition arguments.

According to Technology Acceptance Model mentioned previously, the users' ease of use is a direct determinant of their perceived usefulness of ETS. Finally, various studies suggest that the users' ease of use should be similar to self-efficacy and therefore can be defined as ''judgments of how well one can execute courses of action required to deal with prospective situations.''[10] In addition to the theoretical basis, there are intuitive and practical bases to surmise that the users' perceived ease of use and their self-efficacy for adopting IT is closely linked. Therefore, the perceived behavioral control in our proposed model in Fig. 1 is jointly and positively influenced by the users' perceived ease of use apart from their self-efficacy and facilitating conditions for adopting ETS.

In sum, the preceding theoretical arguments and our proposed model can be formally stated by the following system of simultaneous regression models for further empirical examination.

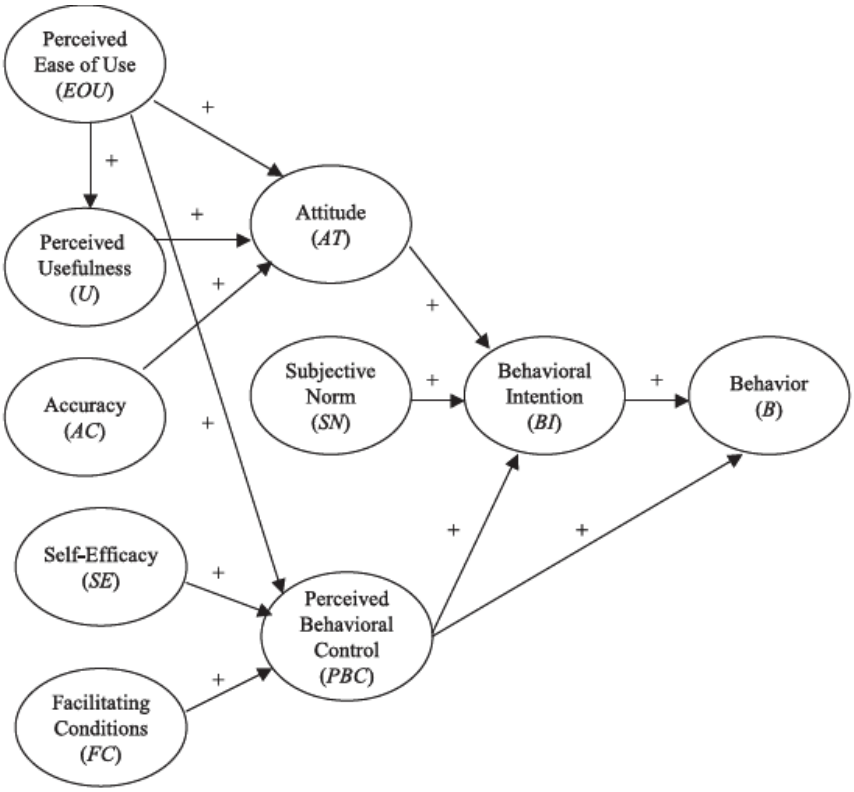

Fig. 1. The proposed model for evaluating the ETS.

$$B = w_1 \times BI + w_2 \times PBC \quad (1)$$

$$BI = w_3 \times AT + w_4 \times SN + w_5 \times PBC \quad (2)$$

$$AT = w_6 \times U + w_7 \times EOU + w_8 \times AC \quad (3)$$

$$PBC = w_9 \times SE + w_{10} \times FC + w_{11} \times EOU \quad (4)$$

$$U = w_{12} \times EOU \quad (5)$$

2. Research methods

Based on the preceding theories and regression models, this section details the subsequent constructs and questionnaire items and the survey settings to collect the empirical data from the end users of the ETS.

2.1. Instrument development

Table 1 shows the detailed constructs in the proposed ETS usage model. To ensure the content validity of the scales, the items selected must represent the concepts in the empirical model under investigation. Therefore, the items selected for the constructs in our model are mainly adapted from prior studies to ensure content validity.

The questionnaire includes two major parts.[11] The first part is composed of thirty-five relevant questions (X_1–X_{20} and Y_1–Y_{15}) as shown in Table 1. The answers for all questions in the first part are coded as seven-point Likert scale from _3 (strongly disagree) to +3 (strongly agree). The second part contains demographic information about the respondents, including age, gender, education, and years of experience in processing the procurement affairs. Items X_1–X_{20} in Table 1 stand for the independent variables that measure the theoretical constructs serving as predictors of the ETS usage in Fig. 1. They include the four items for perceived ease of use (EOU, X_1–X_4), perceived usefulness (U, X_5–X_8), accuracy (AC, X_9–X_{12}), subjective norm (SN, X_{13}–X_{15}), self-efficacy (SE, X_{16}–X_{18}), and facilitating conditions (FC, X_{19}–X_{20}). There are another fifteen observable variables (Y_1–Y_{15}) for intermediate and ultimate dependent constructs including attitude (AT, Y_1–Y_5), perceived behavioral control (PBC, Y_6–Y_9), behavioral intention (BI, Y_{10}–Y_{12}), and actual behavior (B, Y_{13}–Y_{15}).

2.2. Survey settings

Only a limited number of public administrators in Taiwan's central governmental agencies and state-owned enterprises have used the ETS when the survey was performed. Our sample is composed of public officials who are responsible for procurement affairs and businessmen who may be interested in governmental procurement, both of whom are the presumed ETS users under our empirical examination. They are selected by the purposive sampling procedure from various private sectors, state-owned enterprises such as Taiwan Power Company. This is the best alternative for the standard probability sampling due to the early implementation stage for the

ETS. The selected sectors should be the deemed representative as we are keenly aware of the potential bias.

Of all 445 questionnaires distributed, 158 valid questionnaires were returned, with an effective response rate of 35.5 percent. Among them 63.9 percent of the respondents were males. The majority aged between thirty and forty-nine years. Most of the respondents (82.9 percent) have college degrees, and 11.4 percent of whom have obtained master or doctoral degrees. In addition, the respondents have sixteen to twenty years work experience in procurement affairs, and 56 percent of them reply that they have received various ETS training programs. The overall characteristics of the surveyed ETS users therefore have a sound background for adopting ETS in terms of their education, work experience, and training background.

Table 1
Detailed constructs and questionnaire items

Factors	Constructs	Code name	Questions[a]
Attitudinal structure	AT	Y_1	Using the ETS makes me feel (very bad/very good)
		Y_2	It is (very unpleasant/very pleasant) for me to use the ETS
		Y_3	It is (very useless/very useful) for me to use the ETS
		Y_4	I (extremely dislike/extremely like) to use the ETS
		Y_5	I feel (very negative/very positive) about the ETS
	EOU	X_1	It is very easy to use the ETS
		X_2	It is very easy to learn how to use the ETS
		X_3	The ETS instruction is very easy to understand
		X_4	In general, the ease of use of ETS is very good
	U	X_5	The ETS helps me complete the procurement tasks quickly
		X_6	The ETS enhances efficiency of government procurement
		X_7	The ETS makes government procurement much easier
		X_8	Overall, the ETS is very helpful
	AC	X_9	The ETS has very few bugs
		X_{10}	The ETS provides precise information
		X_{11}	The ETS helps me complete procurement tasks accurately
		X_{12}	Overall, the ETS is very reliable
Normative structure	SN	X_{13}	My supervisor thinks that I should use the ETS
		X_{14}	My colleagues think that I should use the ETS
		X_{15}	My organization thinks that I should use the ETS
Control structure	PBC	Y_6	When I use the ETS, I have (no/a lot of) difficulties
		Y_7	Whether or not I use the ETS is completely within my own control (strongly disagree/strongly agree)
		Y_8	I have enough knowledge to operate the ETS (strongly disagree/strongly agree)
		Y_9	In general, I am (extremely incapable/extremely capable) of using the ETS
	SE	X_{16}	I have enough ability to use the ETS
		X_{17}	I have enough knowledge to use the ETS
		X_{18}	The ETS is easy to use on my own
	FC	X_{19}	I own enough required computer equipment to use the ETS
		X_{20}	The Internet network is ease of access
Behavioral structure	BI	Y_{10}	I intend to use the ETS (never/at every opportunity) to handle future procurement cases
		Y_{11}	I plan to use the ETS to complete the procurement tasks (never/very likely)
		Y_{12}	In general, I intend to use the ETS (never/very likely)
	B	Y_{13}	I use the ETS to handle the procurement tasks (never/frequently)
		Y_{14}	I prefer the ETS to the traditional paper process (strongly disagree/strongly agree)
		Y_{15}	So far, the percentage I use the ETS is (very low/very high)

[a] Questions X_1-X_{20} and Y_1-Y_{15} are coded as seven-point Likert scale from −3 (strongly disagree) to +3 (strongly agree).

3. Results and discussions

In addition to descriptive statistical summaries, structural equation modeling was also utilized to examine the integrated ETS model using SPSS and LISREL8 software packages with maximum likelihood estimation.[12] This section shows the evaluations of ETS users in terms of individual

measurements in Table 1 and the overall fitness of the proposed model.

3.1. Evaluations for the current ETS usage

3.1.1. Behavioral factors

Table 2 summarizes the overall evaluation based on the individual questionnaire items in Table 1. Based on both the percentages and mean values, the results for actual behavior (B, Y_{13}–Y_{15}) of the ETS usage appear mixed although the users' intention (BI, Y_{10}–Y_{12}) seems relatively more promising. To illustrate, there remain around 43.7 percent of the respondents with negative evaluations for using the ETS to handle the procurement tasks (Y_{13}) and with 43.0 percent less ETS preference compared to the traditional paper process (Y_{14}) in the future. In addition, only 45.6 percent of the ETS users claimed that they frequently used the ETS (Y_{15}). Compared to the actual behavior, however, at least 70 percent ETS users show more intention to keep using the ETS in the future procurement tasks.

All results reported above are consistent with the status quo of the ETS and with the overall electronic procurement systems. That is, as one of the four subsystems, the ETS has been available but yet to be promoted further. The success for promoting the ETS depends on whether the downstream and crucial electronic bidding system can be implemented. And as of now, the electronic bidding system as well as the accompanying payment mechanism such as e-wallet and electronic procurement card are still under small-scale pilot tests. It is plausible that the actual ETS usage is far less prominent than the users' intention.

3.1.2. Attitudinal factors

The dependent measures of the attitudinal constructs (AT, Y_1–Y_5) stand for the overall satisfaction for the ETS usage. As a result, the ETS users generally reported positive experience from 60.1 percent to 74.0 percent and a maximum of 15.8 percent dissatisfaction. This overall positive evaluation is also captured by three subsequent attitudinal constructs on perceived ease of use (EOU, X_1–X_4), perceived usefulness (U, X_5–X_8), and accuracy (AC, X_9–X_{12}). The least satisfaction of the ETS usage points to the system bugs (X_9, 29.1 percent), which should shed light on where the improvement efforts and resources should be allocated.

3.1.3. Normative factors

The respondents indicated very high support from their supervisors, colleagues, and organizations to use the ETS (SN, X_{13}–X_{15}). The results on the normative factors imply that using ETS is consistent with the organizational and social settings around the ETS users. It also means that the government's plan and investment on the e-procurement and the overall e-government programs have received corresponding support from private firms outside and within the public sectors.

Table 2
ETS users' evaluations on individual questionnaire items

Code name	Questions[a]	Positive (%)	Neutral (%)	Negative (%)	Mean (%)	SD (%)
Attitudinal structure—attitude (AT)						
Y_1	Using the ETS makes me feel (very bad/very good)	62.7	21.5	15.8	0.85	1.46
Y_2	It is (very unpleasant/very pleasant) for me to use	60.1	25.9	14.0	0.83	1.37
Y_3	It is (very useless/very useful) for me to use	71.5	17.1	11.4	1.14	1.32
Y_4	I (extremely dislike/extremely like) to use	64.5	22.8	12.7	0.88	1.31
Y_5	I feel (very negative/very positive) about the ETS	74.0	16.5	9.5	1.31	1.43
Attitudinal structure—perceived ease of use (EOU)						
X_1	It is very easy to use the ETS	74.7	11.4	14.0	1.11	1.40
X_2	It is very easy to learn how to use the ETS	74.1	13.9	12.0	1.15	1.35
X_3	The ETS instruction is very easy to understand	69.6	13.3	17.1	0.89	1.36
X_4	In general, the ease of use of ETS is very good	70.2	17.1	12.7	1.01	1.32
Attitudinal structure—perceived usefulness (U)						
X_5	The ETS helps complete the tasks quickly	68.4	12.7	19.0	0.93	1.56
X_6	The ETS enhances efficiency of procurement	70.2	11.4	18.4	0.94	1.52
X_7	The ETS makes procurement much easier	70.3	10.8	19.0	0.91	1.46
X_8	Overall, the ETS is very helpful	82.7	16.5	10.1	1.18	1.28
Attitudinal structure—accuracy (AC)						
X_9	The ETS has very few bugs in the system	53.1	17.7	29.1	0.48	1.51
X_{10}	The ETS provides precise information	65.2	19.0	15.9	0.94	1.39
X_{11}	The ETS helps me complete tasks accurately	63.3	19.6	17.1	0.82	1.33
X_{12}	Overall, the ETS is very reliable	67.1	20.9	12.0	0.94	1.36
Normative structure—subjective norm (SN)						
X_{13}	My supervisor thinks that I should use the ETS	75.9	19.6	3.8	1.58	1.20
X_{14}	My colleagues think that I should use the ETS	65.8	25.9	8.3	1.21	1.38
X_{15}	My organization thinks that I should use the ETS	58.8	31.6	7.6	1.13	1.44
Control structure—perceived behavioral control (PBC)						
Y_6	When I use the ETS, I have (no/a lot of) difficulties	53.2	26.5	20.3	0.59	1.51
Y_7	Whether I use the ETS is completely within control	49.4	21.5	29.1	0.42	1.65
Y_8	I have enough knowledge to operate the ETS	58.9	19.6	20.5	0.78	1.60
Y_9	In general, I am capable of using the ETS	60.8	22.2	17.1	0.89	1.56
Control structure—self-efficacy (SE)						
X_{16}	I have enough ability to use the ETS	81.0	8.2	10.8	1.54	1.36
X_{17}	I have enough knowledge to use the ETS	84.1	6.3	8.9	1.54	1.36
X_{18}	The ETS is easy to use on my own	80.4	10.1	8.2	1.61	1.36
Control structure—facilitating conditions (FC)						
X_{19}	I own enough required computer equipment	86.1	5.7	8.2	1.71	1.36
X_{20}	The Internet network is ease of access	82.3	7.6	10.1	1.63	1.50

Table 2 (*continued*)

Code name	Questions[a]	Positive (%)	Neutral (%)	Negative (%)	Mean (%)	SD (%)
Behavioral structure—BI						
Y_{10}	I intend to use the ETS to handle procurement cases	71.5	11.4	16.5	1.32	1.67
Y_{11}	I plan to use the ETS to complete the procurement	73.4	10.8	15.8	1.35	1.61
Y_{12}	In general, I intend to use the ETS (never/very likely)	70.3	10.1	19.7	1.20	1.70
Behavioral structure—behavior (B)						
Y_{13}	I use the ETS to handle the procurement tasks	45.6	10.8	43.7	0.04	2.33
Y_{14}	I prefer the ETS to the traditional paper process	43.1	12.7	43.0	0.06	2.19
Y_{15}	Frequency I use the ETS is (very low/very high)	45.6	16.5	28.0	0.15	2.23

[a] Questions X_1–X_{20} and Y_1–Y_{15} are coded as seven-point Likert scale from −3 (strongly disagree) to +3 (strongly agree).

3.1.4. Control factors

We found somewhat mixed results for the criterion variables of the control constructs (PBC, Y_6–Y_9). For example, 20.3 percent of the ETS users replied that they had encountered difficulty in using the system. Around 20.5 percent of the users reported that they did not have sufficient knowledge to use the ETS, and 17.1 percent disagreed with their capability of using the ETS. Looking into the explanatory control constructs on self-efficacy (SE, X_{16}–X_{18}) and facilitating conditions (FC, X_{19}–X_{20}), we found that the respondents actually possess sufficient computer equipments and the Internet resources, with only 8.2 percent and 10.1 percent reporting the insufficient computing resources required by the ETS. The results also show that at least 80 percent of the surveyed ETS users are confident of their computing skills.

Although the preceding results for the individual questionnaire items have shed light on the overall evaluation of the ETS usage, further analyses will be necessary to understand how all the variables reported above interact with each other under our proposed model (Fig. 1) and individual hypotheses. The following two sections attempt to examine the quality of the integrated model.

3.2. Quality of the original and revised model

Confirmatory factor analysis was performed and the results indicated a good fit for the model and a high degree of scale reliability and convergent validity, except for some measures of perceived usefulness (U), accuracy (AC), and self-efficacy (SE). Based on the conventional procedures of structural equation modeling, the path coefficients of questionnaire items X_5 (‘‘The ETS helps me complete the procurement tasks quickly’’), X_9 (‘‘The ETS has very few bugs’’), and X_{17} (‘‘I have enough knowledge to use the ETS’’) in Table 1 are very small and insignificant and thus dropped. Then we conducted the second confirmatory factor analysis on this revised model and assessed its scale reliability, convergent validity, and model fitting. The resulting path coefficients, standard errors, and their significance for the integrated model are shown in Fig. 2.

Consequently, both the internal consistencies and the variance extracted for all the constructs exceed the cutoff values suggested in the literature. The results suggest a marginally good fit for our revised model, with chi-square statistics $v_2(354, n = 158) = 389.2$ with $P = .00$; goodness of fit index (GFI) = .75; normed fit index (NFI) = .90; comparative fit index (CFI) = .90; and root mean square error of approximation (RMSEA) = .079. The R_2 values for behavior, behavioral intention, attitude, subjective norm, and perceived behavioral control are acceptable ($R_B^2 = .35$;

R_{BI}^2 = .57; R_{AT}^2 = .43; R_{PBC}^2 = .38). Based on these criteria, our revised model in Fig. 2 is acceptable in terms of its degree of fitness to the empirical data based on the 158 ETS users. Therefore, it can serve as the model to examine the hypothesized relationships developed above.

3.3. Results for regression model testing

As indicated in Fig. 2, all path coefficients in the integrated model are significant, with the exception of two paths, one from perceived ease of use (EOU) to attitude (AT), and the other from self-efficacy (SE) to perceived behavioral control (PBC).

3.3.1. Determinants of ETS usage behavior

As indicated in Eq. (1), the intention of users to use the ETS and their perceived behavioral control have positive impact on the ETS usage behavior, with the standardized path coefficients .31 and .36, respectively (i.e., the coefficients w_1 and w_2 in Eq. (1)). While consistent with most of the previous research findings,[13] the results also suggest that together with their intention (BI), the users' computing skills and resources available—captured by their perceived behavioral control (PBC)—play an important role in affecting the users' actual ETS usage (B).

3.3.2. Determinants of ETS behavioral intention

Attitude, subjective norm, and perceived behavioral control positively affected behavioral intention based on their standardized path coefficients (.43, .20, and .36, respectively) as shown in Fig. 2. Thus, hypothesized relationships in Eq. (2) are clearly supported. Table 3 below summarizes the total effects of all constructs in the model on the actual ETS usage and behavioral intention. As shown, compared with the subjective norm (total effect .20) and perceived behavioral control (total effect .36) in the same level, the users' overall satisfaction (total effect .43) has the most prominent impact on their intention to use the ETS.

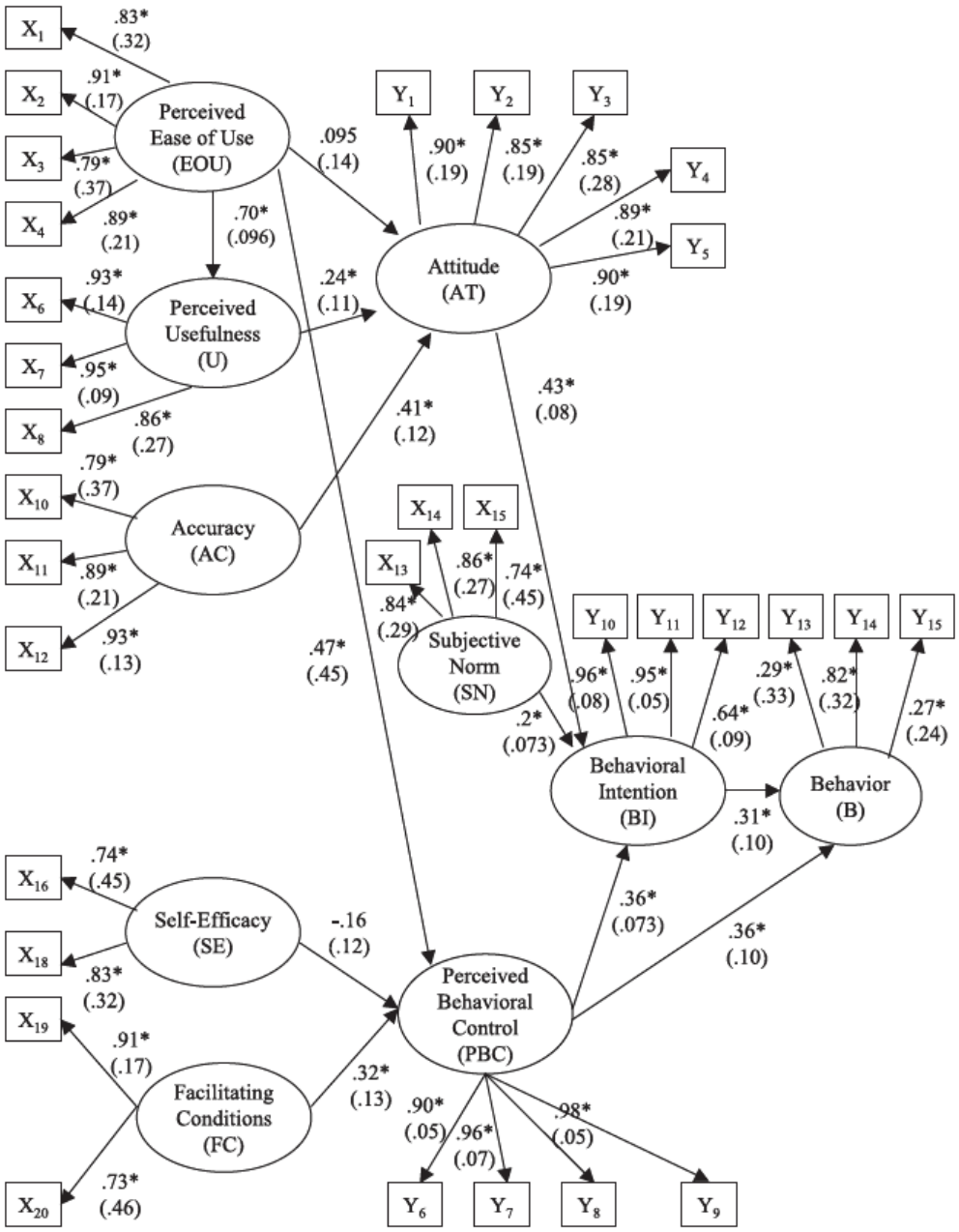

Fig. 2. The path coefficients of the integrated ETS usage model. Note: All numbers are standardized wi standard errors in parentheses.

The critical impact of perceived behavioral control on the actual ETS usage (total effect .47) is also confirmed in Table 3. As hypothesized in the model, the ETS users will have more actual usage when they have more intention and when they possess more computing capability and facilitating resources. Accounting for its direct and indirect effects on the actual ETS usage through behavioral intention, perceived behavioral control has more impact relative to behavioral intention (total effect .31) on the ETS usage.

Table 3
Total effects on behavior (B) and behavioral intention (BI)

Constructs	No. of items	Internal consistency	Variance extracted	Effect on behavior (B)	Effect on behavioral intention (BI)
Behavioral intention (BI)	3	.97	.90	.31	NA
Attitude (AT)	5	.95	.85	.13	.43
Subjective norm (SN)	3	.86	.80	.06	.20
Perceived behavioral control (PBC)	3	.93	.86	.47	.36
Perceived ease of use (EOU)	4	.92	.81	.02[a]	.07[a]
Perceived usefulness (U)	3	.93	.90	.03	.1
Accuracy (AC)	3	.88	.62	.06	.18
Self-efficacy (SE)	2	.93	.80	−.08[a]	−.06[a]
Facilitating conditions (FC)	2	.78	.90	.15	.16

[a] Containing some path without statistical significance at .05.

3.3.3. Determinants of ETS users satisfaction

As a result, the perceived usefulness and accuracy of information provided by the ETS have indeed significant impact on the overall satisfaction as hypothesized in Eq. (3)—with the path coefficients .24 and .41, respectively. However, the perceived ease of use, namely, the friendly user interfaces, does not reach substantial direct influence on the users' satisfaction with the path coefficient .095. Nevertheless, ease of use does have indirect effect on the users' satisfaction through its significant impact on perceived usefulness, with the path coefficient .70. In other words, the friendly ETS system user interfaces do not directly affect the users' satisfaction. Rather, the friendly interfaces make the ETS users perceive the system helpful and thus have a virtual impact on their satisfaction indirectly.

3.3.4. Determinants of perceived behavioral control

In our model, the perceived behavioral control conceptualizes the users' availability of computing skills and resources necessary for using the ETS. The results in Fig. 2 show that it is significantly determined by the facilitating conditions (with the path coefficient .32) and the perceived ease of use (with the path coefficient .47) as indicated in Eq. (4). However, the impact of self-efficacy (with the path coefficient .16) is insignificant. Our empirical evidences imply that the users computing knowledge and skills (i.e., self-efficacy) do not play an important role in the users' overall grasp of available resources for adopting the ETS. A possible explanation may lie in the fact that around 83 percent of the respondents were of the age below fifty and possessed college or higher degree. In other words, computing knowledge and skills may be a hurdle they have already overcome and hence not crucial any more.

4. Policy implications

4.1. Critical roles of facilitating conditions and information accuracy

Total effects of the fundamental level of constructs, including perceived ease of use (EOU),

perceived usefulness (U), accuracy (AC), self-efficacy (SE), and facilitating conditions (FC) on the ETS behavioral intention and actual usage are reported in Table 3. Among them the extent to which the users have computing facility and Internet access (FC) most importantly affects their actual ETS usage and intention simultaneously, with total effects .15 and .16. This implies that the information and communication infrastructure still serve as key success factors for adopting the ETS although Taiwanese government has been investing billions of dollars on the infrastructure since 1995 for promoting a wide array of e-government programs.

In addition, the important role of whether accurate information is provided (AC, with total effect .18) confirms the bottom line of any successful and satisfactory information system. Compared with the relatively weak impact of perceived ease of use (EOU), whether the ETS is really helpful (U) or able to provide accurate information (AC) about the procurement tasks suggests that user-friendly interfaces may have limited power for adopting the ETS. That is, perceived ease of use may be less crucial once the users are satisfied with the interface design. Similar explanations may apply to the even surprising effect of self-efficacy, which may be a hurdle before the ETS users adopt the system. Once the hurdle gets overcome, such as when the users possess sufficient computing knowledge and skills, it becomes less important. All the preceding results are largely consistent with previous findings in the literature, although their study did not explore the effects of information accuracy.[14]

4.2. Perceived behavior control as a significant intermediating factor

Overall, our data analyses suggest that the augmented model (Fig. 1) serves as an adequate model of ETS usage, accounting for a reasonable proportion of the variance in intention and behavior (Table 3). As shown in Fig. 2, the ETS usage behavior is positively influenced by the behavioral intention. Moreover, considering both the direct and indirect effects, the ETS usage behavior is most strongly determined by the users' perceived behavioral control.

The reason why perceived behavioral control has such a significant effect on ETS usage may stem from the implementation status of ETS. While proceeding our investigation, the ETS was newly implemented in certain central government organizations and state-owned enterprises. The respondents had limited opportunities to accomplish their procurement affairs by the ETS. Consequently, they tend to discount their intentions in the formation of their behavior, relying more upon the availability of the resources (PBC) necessary to perform the ETS. This finding is consistent with that reported by Taylor and Todd (1995b) in which the users with less experiences for the system to be adopted, perceived behavioral control has less of an impact on intention but had a significant influence on behavior.[15]

In addition, the traditional paperwork tendering procedure remains functioning, which means the potential ETS users have alternatives even when they are adopting the ETS. This competing behavioral intention between using the original paperwork and the ETS may lead to less willingness to perform the alternative ETS. Such resistance to work-related change may also cause the users to emphasize the control information in the formation of the ETS usage.

4.3. Promoting behavioral intention

It is also important to recognize that behavior is also driven by behavioral intention, which on its own explains 31 percent of the variance in the ETS usage behavior (Table 3). The ETS behavioral intention is strongly determined by attitude toward the system, namely, the users' overall satisfaction and perceived behavioral control, whereas the influence of subjective norm is weaker but still important. These results suggest that providing the users with more allocable resources

serves as a good promotion action for the ETS. In addition, improving the information accuracy and functionality of the ETS should be regarded as another key success factors.

The influence of social pressures modeled as beliefs affected by supervisors, colleagues, and governments positively explains subjective norm. This suggests that programs stressing normative influences via personal network and organizational culture as a part of public policy efforts to promote the ETS may be effective. For example, policymakers might (a) design a campaign to ''tell your employees/coworkers to keep up with the e-commerce trend and use the ETS,'' and (b) provide training programs to educate top managers and then encourage them to urge their organizations and employees to adopt the ETS.

5. Concluding remarks

To promote the ETS intention (BI) and hence actual usage (B), increasing users' overall satisfaction (AT) and equipping them with relevant skills (PBC) serve as a more effective promotion strategy than relying on supervisor and peer pressure (SN). Based on the empirical evidence reported above (Fig. 2 and Table 3), higher satisfaction (AT) can be achieved by providing the ETS users with more useful, reliable and accurate information (U and AC). This is the direction that the ETS, as well as accompanying e-procurement systems and supporting government procurement laws, should go in. In addition, improving facilitating computer and Internet access (FC) effectively improves the users' knowledge and skills (PBC) necessary to adopt the ETS. This implies that public agencies should provide better training programs and more efficient infrastructures to promote the ETS usage.

Our investigations, meanwhile, suggest a more worthwhile exploration. Firstly, it is clear that additional investigation is required to better understand the roles of perceived ease of use and self-efficacy, both of which yield insignificant results. Secondly, only the main effects are considered in our model. The ''buy in'' of a new technological application such as the ETS caused by one's own attitude may be more sustainable. Socially communicated perceptions and beliefs may influence behavioral intention and actual usage of such applications more. In the adoption and diffusion of collaborative systems and e-commerce systems, it is important to study how social influences shape attitudes of users.[16] Therefore, an alternative model with ''crossover'' effects from normative structure to attitude and from control structure to attitude and subjective norm is plausible.[17]

Lastly, although substantial efforts were made to solicit a wide variety of respondents, the study was limited by the purposive sampling procedure and sample size due to the early implementation of the ETS as mentioned earlier. Our sample mainly covered public administrators in central government organizations and state-owned enterprises. Further studies in various public sectors with the sampling issues will be valuable in assessing generalizability of our research findings.

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