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Adopters and non-adopters of e-procurement in Singapore: An empirical study

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ABSTRACT

This study examines various factors associated with the adoption of e-procurement. A survey questionnaire was administered to collect data from 141 companies in Singapore. Using logistic regression analysis, we found that firm size, top management support, perceived indirect benefits, and business partner influence are positively and significantly associated with the adoption of e-procurement. Further, industry type does not show any relationship with e-procurement adoption. Implications of our results are discussed.

1. Introduction

Electronic procurement (e-procurement) has, in recent years, been used as a means to significantly reduce costs, as it enables volume purchases, allows wider choice of buyers and suppliers, brings about better quality, improves delivery, reduces paperwork, and lowers administrative costs [1,2]. In its most basic definition, e-procurement is the streamlining of corporate purchasing processes by eliminating traditional paper-based documents such as purchase orders and requisitions forms. Through an e-procurement system, employees can gain direct access to their suppliers' systems to visually confirm technical specifications and to view product pictures, price points, and detailed product descriptions. The system can also create electronic requisitions for approval, route them through the company's approval process and submit purchase orders electronically to contracted suppliers.

Given the potential benefits of the Internet and other web-related technologies to revolutionize the procurement process, numerous companies worldwide have already adopted e-procurement in an attempt to leverage this technological infrastructure. In an ISM/Forrester Research Report (2001–2003), seven out of ten firms in the US market were reported to have engaged in online procurement of strategic items and critical services (namely those products and services that are closely linked to the firm's production or service delivery). Survey data from the report also show that organizations have experienced between 11% and 12% business growth due to the adoption of e-procurement tools, and 35% of the survey respondents reported cost reductions after adopting e-procurement. As an example, General Electric estimates that the company has saved more than US$10 billion annually through its e-procurement activities [3]. Several studies have also been conducted to examine how the implementation of e-procurement benefits organizations [4–6].

However, some studies have highlighted the risks involved in e-procurement [7,8] as well as the failure of several electronic markets [9]. There are also some evidences reporting the failures in e-procurement [10]. Consequently, it is important to examine the various factors associated with the adoption of e-procurement in organizations.

In a similar vein, research has examined the adoption of information systems (IS) such as electronic data interchange (EDI) [11–13], enterprise resource planning (ERP) [14,15], e-commerce, and e-business [16–18]. Although several

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studies have identified factors conducive to the adoption of IS, relatively few attempts have been made to examine whether these factors are associated with organizational adoption of web-based e-procurement (rather than proprietary EDI). Consequently, organizations may find it difficult to determine whether the factors associated with the adoption of e-procurement would be similar to those for the adoption of EDI or other information technology (IT) applications. Understanding the key factors associated with e-procurement adoption is important so that firms adopting or intending to adopt e-procurement, vendors of e-procurement software, industry groups, and government bodies could take appropriate actions to reinforce the factors if they intend to promote the adoption of e-procurement.

The main objective of this paper is to examine the adoption of e-procurement in Singapore. Specifically, we examine the following research question:

> What are the key factors (technological, organizational, and environmental) associated with the adoption of e-procurement?

In answering the above research question, this study attempts to bridge several gaps in the literature on e-procurement and the adoption of IS. First, by comparing between adopters and non-adopters, we provide a useful reference on organizational characteristics related to the adoption of e-procurement. In other words, we compare the demographic profile and management support between adopters and non-adopters and provide insights on their organizational characteristics. Second, by examining the relative importance of various factors (technological, organizational and environmental) on the adoption of e-procurement, this study advances knowledge on the contingency factors that could potentially affect the adoption of e-procurement in organizations. Third, while various factors have been examined in prior research on topics related to the adoption of EDI and IS innovation, we empirically test the impact of these factors in a new and different context relating to the adoption of e-procurement. Testing in a different context would help us evaluate the consistency of the impact of various factors on the adoption of IS innovation and consequently aid in empirical generalizations [19]. Fourth, most extant studies on e-procurement are confined to Western countries with a serious lack of Asian focus, given the growing importance of the region as a global procurement base. By examining e-procurement in Singapore (a country in Asia), this study fulfils this gap and also provides some insights as to whether findings applicable to western countries are also relevant in this country. Singapore is an ideal place to conduct this study as it has an excellent technological infrastructure and a government in favor of developing IT. Fifth, previous research has provided some evidence that research findings in western countries and Asia could differ. For example, in a study comparing supply chain management between the US and Taiwan, Chow et al. [20] found that while supply chain competencies have positive effects on organizational performance for both countries, the relationship between supply chain practices and concerns may differ. Hence, it is reasonable to expect that some factors associated with e-procurement may be more salient in Asia compared to other western countries. Without empirical testing, it may be difficult to identify which factors concerning the adoption of e-procurement should receive more management attention in Asia.

This paper is organized as follows. First, a literature review of previous studies pertaining to e-procurement is presented. Second, the proposed research model and hypotheses are presented, followed by the methodology used for data collection, and the analyses of the study results. The paper concludes with a discussion of the key findings, limitations, and implications for researchers and practitioners.

2. Literature review

Traditional purchasing processes typically involve a large amount of information processing and communication, thereby making it conducive for IT usage in procurement activities [21]. Hence, e-procurement is a powerful business tool that can revolutionize the buying function of an organization by streamlining and automating the labor-intensive procurement routines.

Over the last decade, there has been a significant change in how companies view their purchasing function. One element that has led to the change is the arrival of e-commerce via the Internet. Since the Internet came of age in the late 1990s, new concepts of Internet-enabled procurement had begun to take shape [22]. Out of simple necessity, the procurement function in organizations has transformed to one that is gaining strategic management focus to generate cost and service advantages. The key catalyst in its evolution has been IT, and the time taken to complete routine purchasing tasks such as order processing has been greatly reduced, allowing the procurement function to focus on other more value adding activities such as supplier development [23].

Previously, a significant part of supply chain and business-to-business (B2B) purchasing has been conducted via EDI, proprietary purchasing systems and electronic mail. Because of its proprietary nature, EDI is expensive to implement, with stringent syntax requirements which necessitate a custom integration among trading partners. What makes Internet-based procurement different is that there is a standard, secure, and reliable universal communication system. Companies can use this universal and global connectivity to execute business transactions, instead of using a set of expensive and complicated networks, as is the case with EDI. Consequently, due to these technical and usage differences, the determinants of EDI adoption may not necessarily be the same as that of web-based e-procurement.

E-procurement involves the use of the Internet and related technologies to perform purchasing activities, with the most basic form being merely buying products and services over the Internet. Along with its advancement, e-procurement has evolved to mean “automating the whole purchasing process and making order and requisition information available along the entire supply chain” [24, p. 56]. With the use of e-procurement systems, the time required to generate a manual purchase order, place the order, and follow up with vendors is greatly reduced to a few simple

clicks of the mouse. Delivery of the order on the same day is also made possible by using e-procurement [25].

Following the increased adoption of the Internet for business uses, the function of procurement is migrating from traditional paper-based processes to e-procurement [1]. The unique features of the Internet and related web-based technologies can potentially support the activities of procurement, and at the same time provide improvements to the procurement process [21]. Examples include *Internet search engines* that help users find information on the desired products and services, *Internet-based catalogs* that enable buyers to browse, search, place, and track orders electronically [26], *Internet-based EDI links* that are more affordable in comparison to the traditional EDI which uses proprietary systems, *Internet-based online auctions and bidding systems* that provide a simple negotiation mechanism to support the negotiation phase of procurement, and *customized Internet-based procurement software* that enable buyers to combine catalogs from several suppliers, check price and availability, place and track orders, and settle payment over the Internet.

2.1. Technology–organization–environment (TOE) framework

The TOE framework [27] identifies three contextual aspects of an organization which influence the process by which the organization adopts and implements a new technology. The technological context defines both the internal and external technologies that are relevant to the firm, including existing technologies which are currently used by the firm, as well as other technologies (and their characteristics) available in the market. For the organizational context, there are a few descriptive measures: firm size and scope, informal electronic linkage and communication, amount of slack resources that are internally available as well as the centralization, formalization, and complexity of the firm's managerial structure. Lastly, the environmental context describes the industrial settings in which an organization conducts its business. These include industry type, level of competition, market uncertainty, governmental dealings, and rules and regulations. In sum, these three contextual factors were postulated to affect organizational decisions regarding technological innovation [27]. Following this logic, the intention of an organization to adopt, or not to adopt, a new technology and the performance impact of e-procurement adoption can be affected by these contextual factors.

A study by Swanson [28] examining the adoption of complex IT innovations revealed that a facilitating technology portfolio, organizational factors such as sufficient slack resources, and a heavy importance placed on the strategic environment, are necessary for such technological adoption. E-business is enabled by technological development [29] and the adoption of which may affect the strategic environment [30]. In addition, there is a need for organizational enablers, and that business and organizational changes may also be required [31]. In view of these organizational and environmental characteristics for technological adoption, Zhu et al. [32] extended the theoretical argument of Swanson [28] to the context of e-business.

In a similar vein, Mishra et al. [33] examine the antecedents and consequences of Internet use in procurement using the resource-based view (RBV) of the firm and the TOE framework. They found that while some resources, such as procurement-process digitization, influence Internet use in both the search stage and the order initiation and completion (OIC) stage, other resources, such as the diversity of organizational procurement knowledge, impact Internet use only in one stage.

A search of the literature on the TOE framework revealed that the framework has been used in the field of information and communication technology (ICT) innovations. The three aspects of technological, organizational, and environmental characteristics have been validated by several studies [11,34–36]. The specific factors within each of the three contextual factors vary across different studies. However, the TOE framework has received consistent empirical support [32]. Hence, the TOE framework provides an appropriate theoretical foundation for this study to examine the factors associated with the adoption of e-procurement.

3. Research model and hypotheses

This study examines the effect of various factors on the adoption of e-procurement. As the research framework in Fig. 1 shows, we identified the following seven factors which are considered to have association with the adoption of e-procurement in organizations. These factors include: (i) perceived direct benefits; (ii) perceived indirect benefits; (iii) perceived costs, (iv) firm size; (v) top management support; (vi) information sharing culture; and (vii) business partner influence. Perceived direct and indirect benefits (analogous to relative advantage in the innovation literature), and perceived costs are listed under technological factors. Under organizational factors, we have firm size, top management support and information sharing culture. Under environmental factor, we examine the role of business partner influence.

Considering that it was not possible to include all potential factors affecting the adoption of e-procurement, the choice of theoretical constructs in our model was determined through an extensive literature review as well as informal conversations with various procurement executives. We began our research process by examining benefits and costs as these factors appear often in our informal conversations with procurement practitioners. As e-procurement involves information sharing, we included knowledge sharing culture in this study. Such a construct is not commonly investigated in adoption studies, so it is included here, given the current emphasis on knowledge management. As for environmental factor, we chose business partner influence that was used in previous studies, as we aimed to test its applicability in a different national context (Singapore).

3.1. Technological factors

Several studies have been conducted to determine the drivers and barriers for the adoption of e-procurement. Costs and benefits of adopting e-procurement are most

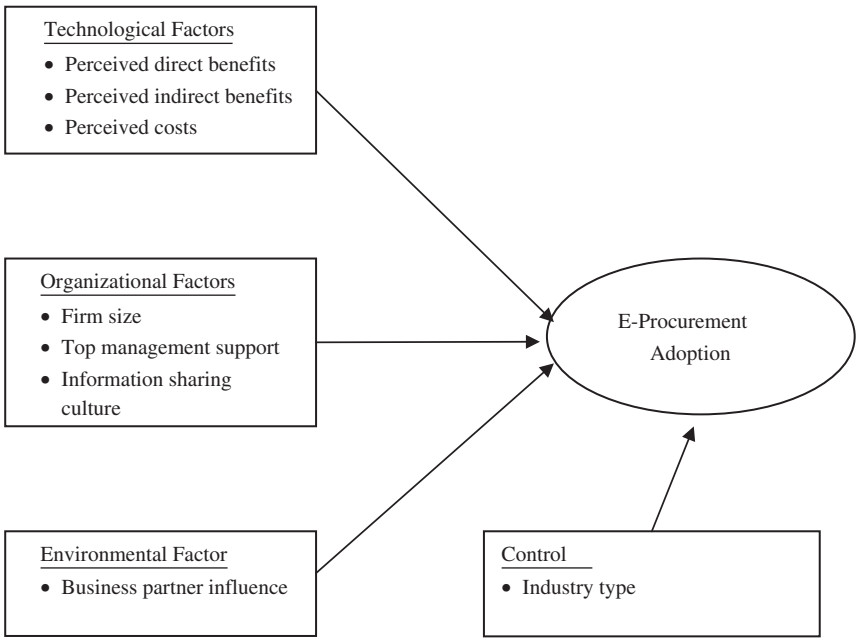

Fig. 1. Research model.

frequently cited as one of the major drivers for initial usage of adopting e-procurement [37]. Perceived benefits are the anticipated or expected advantages that can be provided to organizations [38]. In Chau's and Hui's [34] study on the adoption of EDI, direct benefits are primarily intended for operational savings and are related to the internal efficiency of the organization. Direct benefits include reduction in transaction errors and transaction costs, improved data accuracy and information quality, and faster application process. On the other hand, indirect benefits are associated with the impact of adopting EDI for management of business process and relationships. Indirect benefits include better customer services and improved relationship with business partners.

Both types of benefits affect the adoption of IT, and can be applied to the context of e-procurement. Hence, we have the following hypotheses:

H1. Perceived direct benefits of using e-procurement are positively related to the adoption of e-procurement.

H2. Perceived indirect benefits of using e-procurement are positively related to the adoption of e-procurement.

In addition to perceived benefits, there are also cost considerations by organizations in adopting e-procurement. These costs include the potential administrative and implementation costs which will be incurred as companies utilize e-procurement. As with all technological adoption, the relatively high cost of maintaining and implementing an e-procurement system is a major factor which affects the adoption of e-procurement. Other costs include operating costs, setup costs, and training costs associated with using e-procurement applications. Overall, these costs reflect organizational commitment of financial resources dedicated to the adoption of technology on the belief that firms which perceive the cost to be unduly high or are unable to commit financial resources will be reluctant to adopt e-procurement. Therefore, we have the following hypothesis:

H3. Perceived costs of using e-procurement are negatively related to the adoption of e-procurement.

3.2. Organizational factors

Previous research [36,39] has generally found that larger firms tend to adopt new technologies more rapidly than their smaller counterparts. Likewise, larger firms are more likely to adopt e-commerce [40]. One possible explanation is that larger firms have more resources and may encounter a greater need to stay at the technological forefront than those with smaller operational scale. It follows that:

H4. Firm size is positively related to the adoption of e-procurement.

Top management support and commitment has often been considered crucial in any development and implementation process e.g., total quality management [41], customer relationship management [42], green supply chain management [43], data warehouse [44], and general IT adoption [45]. Previous studies have also identified top management support as a critical issue in e-commerce adoption and deployment [46]. Such support is necessary to ensure that there is commitment of resources as well as cultivation of organizational climate conducive to adopting technological innovation. Further, top management support

is essential in overcoming barriers and resistance to change. It follows that:

H5. Top management support is positively related to the adoption of e-procurement.

As firms enter the highly competitive global marketplace in today's highly digitized business arena, organizations need to consider another organizational factor that can potentially affect the adoption of an IT—a firm's information sharing culture [47]. E-procurement via the Internet requires firms to share information with its business partners. Since e-procurement has evolved to facilitate streamlining and automating the entire procurement process as well as making order and requisition information available along the entire supply chain, information sharing between and within organizations is indispensable. Further, information sharing helps to reduce information asymmetry, thereby also prevent opportunistic behaviors [48]. Further, Lin et al. [49] found that information sharing leads to lower total cost, higher fulfilment rate, and shorter order cycle time. It can also help to reduce information distortion (or bullwhip effect) along the supply chain [50].

Intra-organizational information sharing includes cross-functional exchange of information. For an effective e-procurement system to perform, the system must be integrated with other internal IS such as finance and inventory management [51]. Inter-organizational information sharing would include sharing important information with business partners. For instance, buyers must be willing to share information so as to facilitate communication and flow of goods and services between both parties. However, holding information is often equivalent to developing bargaining power, where the information may be considered as critical and confidential by the buyer [52]. Sharing this information can alter the buyer's position in the buyer–supplier relationship. Organizations need to understand that information sharing may potentially benefit both parties for mutual performance gains [53]. Hence, an organization's willingness to share information can have positive relationship with the adoption of e-procurement. It follows that:

H6. Information sharing culture is positively related to the adoption of e-procurement.

3.3. Environmental factors

E-procurement systems are generally B2B applications. Hence, business partners' influence is crucial in determining the adoption of e-procurement. In fact, previous research on EDI [38,54] has found that business partner influence plays an important role in technological adoption. They suggest that organizations who have adopted EDI would attempt to influence their trading partners to adopt EDI as well, so as to increase their own benefits of adoption. Further, Ellram and Zsidisin [55] found that nature of buyer–supplier relationship affects IT use in the supply chain. Using the institutional theory perspective, Lai et al. [56] argued that it is important to consider the diffusion, market acceptance, and legitimacy of technological adoption to facilitate and support trading and communication among business partners to ensure its effective implementation. Hence, we hypothesize that trading partners have a positive relationship with the adoption of e-procurement. This leads us to suggest the following hypothesis:

H7. Business partner influence is positively related to the adoption of e-procurement.

4. Method

4.1. Sample and procedures

To test the stated hypotheses, we used data collected from a survey conducted in Singapore. The measurement items for the survey were adapted from previous research where their psychometric properties have been established. Multiple items for each construct organized in a survey questionnaire were used for gathering data. Most theoretical constructs were assessed on the basis of a five-point Likert-type scale with the exception of firm size (6-point scale) and top management support (dichotomous scale). A summary of the measurement items is provided in Table 1. In addition, we included industry type (manufacturing versus non-manufacturing) as a control variable. The choice of theoretical constructs to be examined was determined through a review of the technological adoption literature as well as through informal conversations with e-procurement managers, whom we met through our MBA program and executive training programs in Singapore.

The questionnaire went through a pretesting process before it was administered. First, pretesting was carried out with four postgraduate students, one local professor, and one overseas professor. The questionnaire was refined according to the comments/suggestions made by this panel for survey pretesting. The modifications made mainly relate to the instructions in the survey and rephrasing of some measurement items. Next, we obtained feedback from three logistics executives. Since there were no major comments received, the questionnaire was considered ready for data collection. Our target respondents were assured of confidentiality and an executive summary was promised as an incentive to encourage their participation.

Specifically, we captured the following information in our survey:

1. demographic profile (in terms of industry, average annual revenue, number of employees, and number of IT staff);
2. management attitude towards e-procurement;
3. characteristics of e-procurement activities (in terms of types of e-procurement technologies used, types of goods and services procured, and types of e-procurement activities conducted); and
4. factors associated with e-procurement adoption.

The survey was sent to 660 chief executive officers who were requested to forward it to the senior executive who is responsible for e-procurement in their companies. The list of companies and the corresponding targeted executives was obtained from the "Singapore 1000" directory [57]. As larger companies are likely to have more resources and

Table 1
Measurement items and their sources

Item	Description	Source
Technological factors		
H1: Perceived direct benefits (1—strongly disagree and 5—strongly agree)		
The benefits that can be derived from e-procurement include:		
PDB1	Improved data accuracy (dropped)	[34]
PDB2	Improved operations efficiency	
PDB3	Faster application process	
PDB4	Reduced administrative costs	
PDB5	Reduced operations costs	
H2: Perceived indirect benefits (1—strongly disagree and 5—strongly agree)		
The benefits that can be derived from e-procurement include:		
PIB1	Improved competitive advantage (dropped)	[34]
PIB2	Improved customer service	
PIB3	Improved relationship with business partners	
H3: Perceived costs (1—strongly disagree and 5—strongly agree)		
COST1	Lead time to install e-procurement is relatively long	[34]
COST2	Lead time to complete training before starting to use e-procurement is long	
COST3	E-procurement has high setup costs	
COST4	E-procurement has high running costs	
COST5	E-procurement has high training costs	
Organizational factors		
H4: Firm size		
SIZE1	Average annual revenue (< S$10 m, $10–$100 m, $101–$300 m, $301–$600 m, $601 m–$1bn, > 1bn)	[46]
SIZE2	Number of employees (< 100, 100–300, 301–600, 601–1000, 1001–2000, > 2000)	
SIZE3	Number of IT staff (< 10, 11–30, 31–60, 61–100, 101–200, > 200	
H5: Top management support (1—no and 2—yes)		
TMGT1	Interested	[40]
TMGT2	Enthusiastic	
TMGT3	Supportive	
H6: Information sharing culture (1—strongly disagree and 5—strongly agree)		
INFS1	Information sharing is encouraged within my organization	[85,87,88]
INFS2	My organization has a culture of sharing information	
INFS3	My organization values information sharing	
INFS4	Information sharing is practiced by employees	
INFS5	We usually share information among different organizational departments	
Environmental factors		
H7: Business partner influence (1—strongly disagree and 5—strongly agree)		
BPINF1	Important business partners have requested us to use e-procurement	[34]
BPINF2	Majority of business partners have requested us to use e-procurement	
BPINF3	Important business partners have recommended us to use e-procurement	
BPINF4	Majority of business partners have recommended us to use e-procurement	

concerted effort toward the use of e-procurement, we selected companies that have employee establishment of 100 or more.

Three rounds of mailings were carried out and 147 responses were received, of which six were unusable. Eighteen questionnaires were undelivered due to changes in company addresses and resignations of the targeted executives and 14 companies wrote to decline participation. The final usable response rate was 22.5% [(147−6)/(660−18−14) = 141/628], which is consistent with previous studies of similar nature [34]. An early and late respondent bias test was performed to check for potential non-response bias in the respondent sample companies. The results of the chi-square tests indicated no response bias in terms of industry type, average annual revenue, number of employees, and number of IT staff. We also randomly interviewed a dozen respondents to obtain comments for our survey findings. Subsequently, we incorporated some of their comments in the results and discussion sections later in this research paper.

4.2. Validity and reliability assessment

Prior to testing the hypotheses, measurement items in the questionnaire were first assessed for both content and construct validity. To ensure content validity, we carried out an extensive literature search and adopted measurement items from past related research. After which, the survey pretesting was carried out to check and refine the items, if necessary.

Construct validity was evaluated using principal component analysis with varimax rotation. Items were retained

Table 2
Factor analysis and reliability assessment

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Perceived direct benefits (*eigenvalue* = 3.26, *variance* = 12.54, *alpha* = 0.82)							
PDB2	0.057	0.074	−0.052	**0.837**	−0.167	0.112	0.284
PDB3	0.017	0.156	−0.029	**0.846**	−0.076	−0.027	0.105
PDB4	0.092	0.145	0.000	**0.853**	−0.006	0.024	0.122
PDB5	0.203	0.206	−0.101	**0.754**	−0.147	0.149	−0.030
Perceived indirect benefits (*eigenvalue* = 1.70, *variance* = 6.55, *alpha* = 0.67)							
PIB2	0.204	0.061	−0.030	0.272	−0.256	0.176	**0.806**
PIB3	0.328	0.047	−0.057	0.243	−0.150	−0.022	**0.807**
Perceived costs (*eigenvalue* = 3.46, *variance* = 11.54, *alpha* = 0.88)							
COST1	−0.004	−0.038	**0.822**	−0.009	−0.182	−0.073	0.037
COST2	0.122	−0.078	**0.714**	−0.050	−0.060	0.017	−0.118
COST3	0.032	−0.026	**0.834**	0.199	−0.104	−0.144	−0.138
COST4	−0.175	0.214	**0.840**	−0.140	0.104	−0.044	0.104
COST5	−0.133	−0.073	**0.750**	−0.209	0.131	−0.281	0.082
Firm size (*eigenvalue* = 2.41, *variance* = 9.26, *alpha* = 0.84)							
SIZE1	0.124	−0.025	−0.112	0.185	−0.166	**0.813**	−0.014
SIZE2	−0.062	−0.239	−0.022	0.031	−0.014	**0.868**	0.124
SIZE3	0.098	−0.051	−0.309	−0.023	−0.117	**0.819**	0.021
Top management support (*eigenvalue* = 2.70, *variance* = 10.40, *alpha* = 0.92)							
TMGT1	0.106	0.168	0.086	0.067	**0.890**	0.238	0.143
TMGT2	0.168	0.264	0.010	0.153	**0.801**	0.064	0.140
TMGT3	0.111	0.218	0.103	0.160	**0.893**	0.191	0.107
Information sharing culture (*eigenvalue* = 3.57, *variance* = 13.71, *alpha* = 0.87)							
INFS1	0.114	**0.732**	0.183	0.306	−0.155	−0.081	0.177
INFS2	0.119	**0.896**	0.044	0.099	−0.047	0.011	0.133
INFS3	0.085	**0.789**	0.000	0.272	−0.097	−0.083	0.103
INFS4	0.202	**0.762**	−0.157	−0.011	−0.203	−0.115	−0.135
INFS5	0.194	**0.715**	−0.104	0.090	−0.306	−0.125	−0.162
Business partner influence (*eigenvalue* = 3.75, *variance* = 14.43, *alpha* = 0.93)							
BPINF1	**0.867**	0.153	−0.038	0.067	−0.137	0.049	0.119
BPINF2	**0.932**	0.238	0.003	0.114	−0.072	0.023	0.043
BPINF3	**0.909**	−0.011	−0.051	0.094	−0.092	0.048	0.217
BPINF4	**0.918**	0.259	0.012	0.088	−0.096	0.065	0.089

Table 3
Correlation matrix

Constructs	Mean	SD	PDB	PIB	COST	SIZE	TMGT	INFS	BPINF
PDB	3.83	0.66							
PIB	3.54	0.80	0.40**						
COST	3.27	0.81	−0.15	−0.02					
SIZE	2.96	1.40	0.17*	0.17*	−0.27**				
TMGT	1.85	0.34	0.12	0.21	−0.16	0.23			
INFS	3.76	0.68	0.24**	0.16	−0.01	−0.05	0.21*		
BPINF	2.71	0.98	0.19*	0.21*	−0.05	0.13	0.22**	0.18*	
ADOPT	0.62	0.49	0.15	0.30**	−0.21**	0.31**	0.34**	0.15	0.30**

*$p < 0.05$.

**$p < 0.01$ (two-tailed).

based on the following criteria: (i) items with loading of 0.50 or more were retained; (ii) items with loading of less than 0.50 were removed; and (iii) items with loading beyond 0.50 on two or more components were removed. The results of the factor analysis and reliability assessment using Cronbach's alpha are presented in Table 2. The Cronbach's alpha values for all the theoretical constructs were above 0.70 required for adequate reliability [58] with the exception of perceived indirect benefits (alpha = 0.67), which should be noted as a limitation of this study.

The correlation matrix is exhibited in Table 3. None of the correlation coefficients are above the 0.8 level [59], thereby indicating that there is no problem of multicollinearity. As a check for the potential threats of multicollinearity, we also conducted a variance inflation factor (VIF) analysis. VIF measures the impact of collinearity among the predictors in a

Table 4
Demographic profile of the respondent companies

Variable	Adopters ($N = 87$)		Non-adopters ($N = 54$)		Chi-square
	No	%	No	%	
Industry					
Architecture/Engineering/Construction	5	5.7	5	9.3	$\chi^2 = 3.580$
Banking/Finance/Insurance/Property	6	6.9	3	5.6	df = 8, $p = 0.893$
Business services	5	5.7	4	7.4	
Computer/IT	8	9.2	4	7.4	
Logistics/Transportation/Communications	8	9.2	5	9.3	
Manufacturing	34	39.0	17	31.5	
Retail/Trading/Wholesale	7	8.0	5	9.3	
Travel/Tourism/Hotel	3	3.4	5	9.3	
Others	11	12.6	6	11.1	
Average annual revenue					
< S$10 million	2	2.3	4	7.4	$\chi^2 = 11.398$
S$10–S$100 million	15	17.2	19	35.2	df = 5, $p = 0.044$
S$101–S$300 million	24	27.5	15	27.8	
S$301–S$600 million	18	20.7	6	11.1	
S$601 million–S$1 billion	2	2.3	1	1.9	
> S$1 billion	19	21.8	5	9.3	
Number of employees					
< 100	8	9.2	6	11.1	$\chi^2 = 17.213$
100–300	21	24.1	25	46.3	df = 5, $p = 0.004$
301–600	11	12.6	12	22.2	
601–1000	13	14.9	3	5.6	
1001–2000	12	13.8	1	1.9	
> 2000	22	25.3	7	13.0	
Number of IT staff					
< 10	41	47.1	41	75.9	$\chi^2 = 13.289$
11–30	18	20.7	4	7.4	df = 5, $p = 0.021$
31–60	6	6.9	3	5.6	
61–100	4	4.6	2	3.7	
101–200	6	6.9	3	5.6	
> 200	11	12.6	1	1.9	
Top management support					
Interested					
Yes	45	97.8	23	63.9	$\chi^2 = 16.428$
No	1	2.2	13	36.1	df = 5, $p = 0.000$
Enthusiastic					
Yes	34	87.2	17	54.8	$\chi^2 = 9.135$
No	5	12.8	14	45.2	df = 5, $p = 0.003$
Supportive					
Yes	66	100.0	29	76.3	$\chi^2 = 17.112$,
No	0	0.0	9	23.7	df = 5, $p = 0.000$

regression model on the precision of estimation. In other words, it expresses the degree to which collinearity among the predictors degrades the precision of an estimate. We found the VIF values for the theoretical variables fall in the range from 1.06 to 1.25, which is far below the cut-off value of 10 [60,61]. Such a test result indicated that multicollinearity is not a problem for this study.

5. Results and discussion

5.1. Demographic profile

Out of the total 141 respondent organizations, 87 (61.7%) are adopters of e-procurement while the remaining 54 (38.3%) organizations are non-adopters. This finding represents a significant increase from an earlier study by Kheng and Al-Hawamdeh [37], which indicated that only 35% of their respondent organizations had implemented e-procurement. This increase reiterates the fact that e-procurement is increasingly being used by various organizations.

Out of a total of 54 non-adopters, 10 organizations expressed interest in adopting e-procurement within the next 12 months, while 33 had no intention of adopting e-procurement within the next 12 months. The remaining 11 companies did not express any intent to adopt or not to adopt e-procurement. Some of the most frequently cited

reasons for non-adoption include lack of business partner readiness, irrelevance of the technology to business, budget issue, and lack of cost-benefit results.

Table 4 compares the organizational characteristics of the adopters of e-procurement with those of the non-adopters using chi-square tests. No significant relationship was found between industry sector and the adoption of e-procurement. However, results were significant in terms of firm size and top management support. Interestingly, while both adopters and non-adopters have positive management attitude towards e-procurement, the positive attitude among adopter firms was significantly stronger than that of non-adopter firms.

5.2. Characteristics of e-procurement activities

For adopters, the average period for their use of e-procurement systems was 3.91 years (standard deviation = 2.6), with the longest period of use being 10 years, and the shortest period of use being half a year. Further, 64.4% of adopters have formal plans for their e-procurement initiative, and 54.0% of adopters also have formal task force overseeing e-procurement.

In addition, 43.7% of adopters indicated that less than 10% of their employees have access to e-procurement system, and 23.0% of adopters had 11–20% of their employees granted access to e-procurement systems. About 15% of adopters had more than 50% of their employees given access to e-procurement systems. These results indicate that access to e-procurement systems tend to be restricted to less than 20% of employees which is not surprising considering the specialized nature of procurement activities.

Moreover, 48% of adopters spent less than 4% of their annual revenue on e-procurement while 21% spent more than 10% of their annual revenue on e-procurement. These results indicate that spending on e-procurement tends to occupy a small percentage of annual revenue.

The types of e-procurement technologies used by adopters are summarized in Table 5. The most commonly used e-procurement technology is customized e-procurement software, which is used by 57 (70.4%) of adopters. This is different from Rajkumar's [62] study on e-procurement technologies, which revealed that e-catalogue is the most widely used e-procurement technology. The least used technology is electronic marketplaces, which garnered only 18.5% of usage from adopters. Other types of e-procurement technologies indicated by adopters include ERP software, EDI and emails.

Table 5 also shows that maintenance, repair and operations (MRO) items are most commonly procured via the Internet (57.6%), followed by manufactured goods (43.5%) and raw materials (47.4%). Other items procured over the Internet include software, books, licenses, office equipment and accessories, finished goods, office supplies, indirect services such as consultation and technical services, trading goods, and information.

In terms of the types of e-procurement activities conducted by adopter organizations, Table 5 shows that email correspondence between buyer and seller is most common (90.8%). One possible explanation is the proliferation of the use of the Internet for commercial activities in Singapore, as well as in global business. Sending request for proposal (RFP), request for information (RFI) and request for quotation (RFQ), identifying new suppliers and research into suppliers' markets via the Internet, and collection and distribution of purchasing information are also some of the most commonly conducted e-procurement activities (69.0%, 67.8%, and 65.5% of adopters, respectively). This could be due to the fact that the Internet provides an inexpensive and convenient way to gather such information. Other types of e-procurement activities conducted by adopters include electronic bidding, reverse auction, integrating the logistics system, and integrating with users/customers' requisitions, and supply chains to warehousing and distribution globally.

Table 5
Characteristics of e-procurement activities

Characteristics of e-procurement activities	(%)
Types of e-procurement technologies used	
Customized e-procurement software	70.4
Electronic catalogue	29.6
Electronic auction	27.2
Electronic marketplace	18.5
Others	6.2
Types of goods and services procured	
Maintenance, repair, operational (MRO) items	57.6
Production goods	43.5
Raw materials	42.4
Other items	27.4
Types of e-procurement activities conducted	
Email correspondence between buyer and seller	90.8
Sending Request for Proposal (RFP), and/or Request for Information (RFI), and/or Request for Quotation (RFQ) to trading partners	69.0
Identify new suppliers and research into suppliers Markets	67.8
Gathering and distributing purchasing information both from and to internal and external Parties	65.5
Electronic order placement	62.1
Price and availability checking	60.9
Tracking orders	56.3
Integration of procurement within the internal systems	52.9
Electronic payment	48.3
Creating and approving purchase requisites	47.1
Email in contract management	44.8
Electronic submission of tenders	34.5
Advertising tenders	17.2
Other e-procurement activities	8.0

5.3. Factors associated with e-procurement adoption

In this study, the dependent variable, namely e-procurement adoption was measured as a dichotomous variable. Logistic regression analysis was used as it has fewer assumptions (independent variables need not be normally distributed, linearly related, or have equal within-group variances) compared to discriminant analysis. Further, researchers have generally found logistic regression to be more robust and easier to interpret compared to discriminant analysis [63]. Before analyzing the data, we examined

Table 6
Logistic regression analysis

Constructs	*B*	S.E.	Wald	df	Sig.	Exp(*B*)
Constant	−4.50	2.62	2.96	1	0.043	0.011
Control						
Industry type	0.35	0.48	0.52	1	0.235	1.414
Technological factors						
Perceived direct benefits	0.14	0.37	0.14	1	0.353	0.868
Perceived indirect benefits	0.84	0.34	6.04	1	0.007	2.307
Perceived costs	−0.34	0.30	1.24	1	0.133	0.714
Organizational factors						
Firm size	0.50	0.21	5.92	1	0.008	1.655
Top management support	1.32	0.71	3.48	1	0.031	0.267
Information sharing culture	0.61	0.37	2.75	1	0.067	1.845
Environmental factor						
Business partner influence	0.58	0.26	4.86	1	0.014	1.787
Chi-square (df = 8, $p < 0.01$)	45.64					
−2 log likelihood	123.58					
Nagelkerke R^2	0.41					
Correctly classified adopters (%)	89.00					
Correctly classified non-adopters (%)	55.30					
Correctly classified overall (%)	76.70					
Chance accuracy	53.40					
Hosmer–Lemeshow test						
Chi-square (df = 8)	12.69					
Significance	0.123					

the standardized residuals to identify potential outliers and we found no such outliners in the check.

Table 6 shows the result of logistic regression analysis for our hypotheses on the adoption of e-procurement. The test result is significant (chi-square = 45.64, df = 8, $p < 0.01$) thereby indicating adequate fit of the survey data to our model. The Nagelkerke R^2 provides an analogy to R^2 in ordinary least square multiple regression; it indicates that 41% of the variance is explained by the independent variables. The results also indicate that the overall percent correctly classified is 76.7% compared to 53.4% obtained by chance. Hair et al. [64] suggested that if the classification accuracy is greater than 25% (i.e., 1.25∗53.4% = 66.8%), the classification accuracy is acceptable as in the case of our overall classification accuracy.

The Hosmer and Lemeshow Goodness-of-Fit Test provides an overall test of the fit of the data to our model. It is generally considered more robust than general chi-square test. Hosmer and Lemeshow Goodness-of-Fit Test divides the data into deciles based on predicted probabilities and computes a chi-square from observed and expected frequencies. If the Hosmer and Lemeshow Goodness-of-Fit test statistic is 0.05 or less, we reject the null hypothesis that there is no difference between the observed and predicted values of the dependent variable. If it is greater than 0.05, we accept the null hypothesis that there is no difference between the survey data and our model. The value of 0.123 indicates a reasonable fit of our data to the model.

In Table 6, the Wald statistic and the corresponding level of significance test the effect of each of the independent variables in the model. The ratio of the logistic coefficient *B* to its standard error S.E., squared, equals the Wald statistic. If the Wald statistic is significant (i.e., less than 0.05) then the parameter is significant in the model. The "Exp(b)" column indicates the predicted change in odds for a unit increase in the corresponding independent variable. In other words, odds ratios less than 1 correspond to decreases and odds ratios more than 1.0 correspond to increases in odds. Odds ratios close to 1.0 indicate that unit changes in that independent variable do not affect the dependent variable. The statistical power obtained using PASS2008 software is 0.80, which is considered adequate for us to proceed with the regression analysis [65].

The results indicate that there is no significant relationship between industry type and e-procurement adoption. This is in line with Teo and Tan's [39] findings that industry sector has no significant relationship with the adoption of the Internet. It is also consistent with Teo and Ranganathan's [40] findings that adopters and non-adopters of e-commerce do not differ in terms of industry sector. One plausible explanation is that IT has proliferated throughout the economy regardless of industry sector, as companies constantly look for better ways to rationalize their operations and compete

more effectively. A director of procurement commented:

> E-procurement has been around for some time. So most industries should have adopted it.

In terms of hypothesized factors associated with e-procurement adoption, the results were significant for perceived indirect benefits, firm size, top management support, and business partner influence, thereby supporting H2, H4, H5, and H7. The results for perceived direct benefits, perceived costs and information sharing culture were not significant. Hence, H1, H3, and H6 were not supported.

Several studies on the adoption of ICT innovations had identified perceived benefits and/or perceived costs as important factors associated with technological adoption [66–68]. Following Chau and Hui [34] and Kuan and Chau [35], this study distinguished direct from indirect benefits. However, in contrast to Chau and Hui's study on the adoption of EDI by small business, perceived indirect benefits was found to be an important factor associated with the adoption of e-procurement, instead of direct benefits. This could be due to the fact that organizations in the sample are evenly distributed in terms of organizational size. Whereas small businesses tend to be more focused on day-to-day operational efficiency and hence, on immediate benefits [34,69], medium and large sized businesses may tend to perceive benefits in the long run to be of more strategic importance.

Compared to direct benefits such as reduced administrative and operations costs, and improved operations efficiency, indirect benefits represent a broader scope of benefits which can be gained, such as improved customer services and better relationship with business partners. The positive relationship between indirect benefits and e-procurement adoption suggests that e-procurement is considered by organizations as a tool to enhance relationships with customers and business partners, which is something that enables them to gain major strategic benefits in the long run. The adoption can be accounted for by how organizations view their initiatives in adopting e-procurement. Since such initiatives for adopting technology could be costly, organizations may tend to view it as a long-term investment. Hence, when considering the adoption of e-procurement, organizations may be more concerned with the broader scope of benefits that the technology can bring and how it can provide more strategic gains, rather than the direct benefits of e-procurement. Another possible reason is that since the direct benefits tend to be widely reported in trade press, respondents are generally aware of them, and hence the result for direct benefit is not significant.

Surprisingly, although the relationship between perceived costs and adoption is in the expected negative direction, the result is not significant. One plausible reason is that although Internet-based e-procurement may be costly, it entails much lower costs compared to traditional proprietary EDI-based procurement.

The results also indicate that firm size is significantly related to the adoption of e-procurement. This finding is consistent with the study by Teo and Tan [39] who found that average annual revenue and the number of employees were significantly related to the adoption of the Internet. Banerjee and Golhar [70] and Germain and Droge [71] have also reported that larger companies are EDI users. With higher average annual revenue, adopter firms may encounter more financial slack and hence allocate higher budgets to embark on their IT initiatives. Adopter firms also had a larger work force as well as more IT staff, and hence may have more expertise and manpower to complement their adoption and implementation of e-procurement. A possible explanation for such phenomena is that, for larger firms with more resources, they may have a greater need to keep ahead in technological advances than their smaller counterparts. A senior manager commented:

> Our firm is relatively small and hence was a bit slow in adopting e-procurement as we wanted others to test the technology first. This also allowed us to conserve our resources and learn from others.

In addition, top management support shows a significant positive relationship with e-procurement adoption. The importance of top management support is consistent with Hsiu et al's [72] study on factors affecting the adoption of e-commerce, which revealed that top management support correlates significantly with the success of the adoption. It is also consistent with Teo and Ranganathan's [40] study, which found that adopters of B2B e-commerce received higher level of support from top management and functional managers than that for the non-adopters. Grover [73] also found a significant relationship between top management support and the adoption of EDI. In a similar vein, Rai et al. [74] found that top management support was associated with e-procurement assimilation while Premkumar [75] found that top management support is an important determinant of the adoption of computer-mediated communication technologies. This suggests that top management support for an organization's IT initiative is essential in determining its adoption, as expressed by a purchasing manager in the hotel and food and beverages industry:

> The adoption of e-procurement, or any other kind of information technology for that matter, has to be done through a top down approach. The bosses and top management have to realize how the technology can improve organizational performance first. Only then can they be supportive of its use. Once the IT adoption becomes a top down approach, employees would then be more convinced and supportive of using the technology in question.

One explanation for the insignificant relationship between information sharing climate and e-procurement adoption could be that the adoption may be more affected by other factors such as market trends and internal and/or company specific objectives and concerns. Consequently, information sharing may be less of a key differentiator between adopters and non-adopters of new information technologies. A purchasing general manager from the

manufacturing industry commented that:

> E-procurement adoption is more influenced by other factors such as market trends. If there was a period whereby vendors are actively promoting e-procurement, chances are that firms may be more likely to adopt e-procurement. For information sharing, it is not that important because all the information that is needed is usually specified in contracts.

The positive influence of business partners on the adoption of e-procurement is in line with Power and Sohal's [76] study on e-commerce implementation and usage, which revealed that the adoption of e-commerce is essentially driven by trading partners. Bouchard [77] also reported that business partner requirement is an important factor associated with the adoption of EDI. One reasonable explanation is that since e-procurement requires the cooperation and coordination of business partners in order for the system to function to its full potential, as more business partners adopt or recommend the use of e-procurement, organizations are likely to follow suit. This explanation is further echoed by several respondents:

> As our business and industry is very much driven by customers, e-procurement is a must. Our suppliers are very much into e-procurement and therefore we cannot afford not to be there.—Supplies Manager, Business Services industry.
>
> Business partner influence is important. We have no choice. If everyone is using e-procurement and you are not on the band wagon, then you're out. Especially for a very important business partner, if they requested for us to use e-procurement and we do not oblige, then we won't have their business.—Director, Indirect Procurement, Manufacturing industry.
>
> I would say it (business partner influence) is very important in the decision to adopt e-procurement. That is why we sometimes have to 'force' our vendors to use reverse auctions. If you want the business, you have to do it.—Senior Assistant Engineer, Purchasing Department, Business Services industry.

6. Supplementary data analysis

The focus of our paper is on adopters versus non-adopters with respect to e-procurement. Hence, in the above analysis, we operationalize adoption as a dichotomous variable. For further research insights, we also collected data for measuring the extent (level) of usage of e-procurement among adopters. Karahanna et al. [78] has suggested that pre-adoption and post-adoption beliefs might be different. Hence, we eliminated non-adopters before we carried out supplementary data analysis. We operationalize the extent of usage of e-procurement by using four measurement items: "The number of items procured electronically is …", "The variety of items procured electronically is …", "The number of functional units that can procure items electronically is …", and "The number of internal business processes that process items electronically is …" [79] measured on scale: 1[0–20%], 2[> 20–40%], 3[> 40–60%], 4[> 60–80%], 5[> 80–100%]. We performed factor analysis by including these four items with the other independent variables and found that the items loaded as expected onto their respective theoretical constructs. The Cronbach alpha value for measuring the extent of usage of e-procurement is 0.90. We also checked the VIF values and found that they range from 1.12 to 1.46, thereby indicating that multicollinearity is not a problem. Consistent with Thong's [36] work, we used partial least squares (PLS) [80] to analyze the results. PLS places minimal restrictions on measurement scales, sample size, and residual distributions. Further, PLS analysis is distribution free and does not assume true independence of the variables, leading to more reliable results. In addition, PLS is also robust against other data structural problems such as omissions of regressors and skew distributions [81,82]. In the PLS model, all measurement items were modeled as reflective indicators of their underlying latent theoretical constructs and bootstrapping with 200 resamples was used to examine significance levels.

The composite reliability values of all the constructs in the model were equal or above the 0.70 threshold [83], thereby indicating adequate internal consistency. We assessed convergent validity by examining the average variance extracted (AVE) for each construct. The AVE for a construct reflects the ratio of the construct's variance to the total variances among the items of the construct. As shown in Table 7, all AVEs were above the 0.50 threshold suggested by Fornell and Larcker [83]. Discriminant validity can be inferred when the variance of each construct is larger than the variance shared by this construct with any other construct in the model [84]. The variance of a construct is indicated by AVE, while the variance shared by two constructs can be calculated by squaring the correlation between them. The AVEs are much larger than the squared correlations among the constructs, thereby satisfying the criteria for discriminant validity.

The R^2 value we obtained is 0.21 which is about half as compared to that obtained earlier in the logistic regression analysis. The results of PLS analysis (Table 7) indicate that perceived costs, firm size, and information sharing culture were significantly associated with the extent of usage of e-procurement. The rest of the constructs were not significant in the analysis. The statistical power was 0.92 which is adequate in the analysis.

These results are interesting in that, while perceived indirect benefits are associated with the adoption (Table 6), perceived costs are negatively associated with the *extent* of usage of e-procurement (Table 7). One plausible reason is that, while making the adoption decision, firms tended to pay more attention to the indirect benefits from the adoption since the costs of adopting e-procurement tends to be much lower than that for adopting proprietary EDI systems. However, this attention switches to a focus on cost as firms begin to use e-procurement more extensively.

In addition, both top management support and business partner influence show significant positive relationships with the e-procurement adoption (Table 6) but not with

Table 7
PLS analysis for factors associated with extent of usage on e-procurement

Constructs	Composite reliability	Average variance extracted	Path coefficient
Control			
Industry type	1.00	1.00	0.11
Technological factors			
Perceived direct benefits	0.81	0.63	0.01
Perceived indirect benefits	0.70	0.58	0.05
Perceived costs	−0.91	0.66	−0.20*
Organizational factors			
Firm size	0.92	0.76	0.24**
Top management support	0.97	0.92	0.05
Information sharing culture	0.90	0.64	0.22*
Environmental factor			
Business partner influence	0.95	0.83	0.07

*$p < 0.05$.

**$p < 0.01$.

the extent of usage of e-procurement (Table 7). It appears that once top management has committed to adopting e-procurement, top management support becomes less of an issue in determining the extent of usage. In a similar vein, it appears that business partner influence is more salient in the decision to adopt and becomes less salient in determining the extent of adopting e-procurement. A plausible explanation is that once the adoption decision has been made, other factors become more salient in determining the extent of usage of e-procurement.

As for information sharing, the finding suggests that information sharing is considered more important when an organization has already adopted the technology, and is deciding the extent of its usage. One possible explanation could be that for a greater extent of usage, more information sharing must be present. Hence, firms must be willing to share more sensitive information if they want to use e-procurement to a greater extent.

7. Limitations

This study has the following limitations. First, we used the TOE framework to examine some key variables associated with e-procurement adoption. Future research could examine other factors associated with e-procurement using different theoretical lenses such as resource dependency theory or social dilemma theory. Further, future research could also examine other factors salient to the Singapore context such as government policy/regulation, technology infrastructure and culture. Second, we did not explicitly distinguish among the different types of e-procurement technologies, types of goods procured and types of e-procurement activities in our research model. Future research can examine these factors in greater detail. Third, our study is cross-sectional in nature and the results indicate association between various contextual factors and e-procurement adoption rather than their causality. Future research can perform a longitudinal study where causality can be established. Fourth, the study is based upon perceptual measures from a single respondent in a company. This may result in a certain degree of informant bias. To reduce the potential bias, we administered the survey to the senior executive responsible for e-procurement, as they are more likely to possess the necessary knowledge to respond about the firms' e-procurement activities. We have also tried to overcome this limitation by conducting interviews with some respondents to triangulate our results. In addition, we conducted the Harmon's test and found that none of the factors accounted for a significant proportion of the variance, thereby suggesting that common method bias is not a problem. As a second method of assessing common method bias, we used a marker variable to adjust partial correlation to control for this bias [85,86]. We chose tenure of respondents in the firm as the marker variable since it is theoretically unrelated to the theoretical constructs examined in this study. After partial correlation adjustment, all significant zero order correlations remained significant, providing further evidence that common method bias is not a serious problem in our study.

8. Conclusions

The results from this study provide organizations with a better understanding of factors associated with the adoption of e-procurement, which will be useful reference for them to develop appropriate e-procurement strategies. Specifically, the key factors in order of importance are perceived indirect benefits, firm size, business partner influence, and top management support. It appears that firms may be generally aware of the direct benefits (this explains why there is no difference between adopters and non-adopters). Hence, adopter firms tend to emphasize indirect benefits possibly due to their focus on indirect long term benefits rather than direct short term gains. In general, large organizations have more resources and greater need for e-procurement as compared to smaller organizations. Consequently, larger firms stand a higher chance to adopt e-procurement. The

results also indicate that business partner influence plays a significant role in e-procurement adoption. Hence, organizations (especially the larger ones) that have adopted the technology can potentially request the technological adoption by their business partners.

Top management of firms should realize that the basic function of e-procurement is to streamline the procurement process for more effective communication and procurement efficiency. Knowledge of what e-procurement encompasses should be useful before determining the adoption. Top management commitment and support is essential for e-procurement adoption. Organizations should also understand that the use of e-procurement is increasingly widespread in the global business world. This is evident in our finding that industry type has no relationship with e-procurement adoption. In order to stay competitive, it may be inevitable that non-adopters take part in e-procurement to avoid losing their customers and businesses. Decision makers have to understand and evaluate what their businesses require before planning and implementing the e-procurement system.

This study is also useful for proponents of e-procurement, especially software vendors. Vendors are provided with an insight into the factors that are significantly associated with e-procurement adoption. Equipped with this information, vendors can thus devise more effective and efficient promotion strategies for their e-procurement software. For example, software vendor can focus their attention on convincing top management about the benefits of e-procurement and leverage the influence of business partners to accelerate the adoption. Vendors should realize that although larger firms appear more receptive to e-procurement, small and medium sized firms also represent a significant potential market. By convincing larger firms to adopt e-procurement, small and medium sized firms who are business partners with larger firms may be encouraged to adopt e-procurement.

By understanding the factors associated with the adoption of e-procurement, government policy makers could design appropriate measures to encourage the adoption of e-procurement. For example, government could provide financial support or tax rebates to firms in order to promote the benefits of adopting e-procurement and its diffusion. Governments could also play a lead role in adopting e-procurement which in turn can influence their business partners towards adopting e-procurement.

In summary, this study contributes to the existing literature by providing valuable insights into e-procurement by comparing the organizational characteristics of adopters and non-adopters as well as characteristics of their e-procurement activities. Although the results show that adopter firms were larger and had better top management support than non-adopter firms, there was no significant difference in the adoption in terms of industry types. This indicates that e-procurement is applicable to a wide range of industries. In addition, the results show that the key factors associated with organizational adoption of e-procurement include perceived indirect benefits, firm size, top management support, and business partner influence. These results also provide useful references on the relative importance of various factors associated with the adoption of e-procurement.

The lack of support for direct benefits and the support for indirect benefits warrants further research. Conceivably, e-procurement has increasingly become an essential part of the firms' procurement activities and firms are realizing the importance of indirect benefits as direct benefits may be difficult to quantify and need longer time to take effect. In a similar vein, the lack of relationship of information sharing culture with the adoption of e-procurement would need further research attention. Interestingly, the lack of relationship of perceived costs with e-procurement adoption could suggest that firms are generally aware of the benefits of e-procurement. Specifically, Web-based e-procurement entails significantly lower costs than proprietary EDI systems.

The results of supplementary data analysis, by modeling the adoption in terms of usage of e-procurement as a continuous variable, indicate that the significant factors associated with the adoption may be different from those associated with its usage. Previous research tends to operationalize adoption either as a dichotomous variable or as a continuous variable, rather than examining them together (with the exception of Thong [36] who examined adoption and extent of adoption in the context of IS adoption in small businesses). Hence, this study contributes to the literature in this line of research by comparing the factors associated with both the adoption and the extent of usage of e-procurement. It also validates Thong's findings that factors affecting adoption and extent of adoption may be different. Future studies can also examine other factors, e.g., cultural and institutional, associated with e-procurement adoption.

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