

E-Procurement Institutionalization in Construction Industry in Developing Countries: A Model and Instrument

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Abstract:

The adoption of e-commerce technologies is a progressively interactive multi-phase process. Existing literature on the adoption has not been paid appropriately attention on this nature. This study distinguishes the difference between initial adoption and institutionalization of e-procurement and provides a particular focus on the investigation of determinants of e-procurement adoption in construction sector in developing countries' context. It uses formative measurement to model exogenous latent variables. As a result, a theoretical model and an instrument are constructed and empirically tested by using data collected in Hanoi. The sophistication of e-procurement is essential to gain full benefits from the technology; therefore, specific studies on institutionalization of e-procurement, for instance this present work is very necessary. Further research with larger sample need to be conducted to validate additionally the model and instrument proposed.

Key-Words: e-procurement; initial adoption; institutionalization; construction industry; developing countries

1 Introduction

Empirical studies consistently demonstrate that e-procurement makes potentially significant benefits to construction enterprises [1]. However, in both developing and developed countries, the diffusion and adoption of e-procurement in construction sector has fallen far below expectations. Most construction companies adopt the technology only at the simple but not integrated level [2].

The evolution of the strategic role of a specific e-commerce technology (e.g. e-procurement) is closely linked to its sophistication or integration. Literature consistently demonstrates that the sophistication of an innovation (e.g. IT systems, advanced manufacturing systems) significantly and directly affects the operational performance, the business performance, and the service performance of enterprises [3-5]. In addition, empirical evidence also indicates that the assimilation of e-procurement innovations (i.e. e-reverse auction, e-catalog, e-payment and settlement) considerably improves procurement productivity [6]. It can be said that in

order to gain full benefits and maximize potential advantages from e-commerce technologies, a firm or an organization must first accept, adopt, use and then institutionalize fully these technologies in terms of technology, information, management and usage. In light of this, studying the factors that speed up firms move on from an initial adoption to institutionalization of e-procurement is an important consideration for an understanding of the adoption and improving success of e-procurement.

In fact, there have still been many practical problems need to be explained. For instance, despite having the same resources and operating environment, some firms have implemented more sophisticatedly e-procurement applications while others do not. Several construction enterprises have adopted initially one or multiple simple e-procurement innovations for a long duration, and even though they have mature resources for e-commerce, but they did not conduct any subsequent implementation of the technology ([7], pg.98). Furthermore, [8] and [9] agreed together that the factors that affect initial e-commerce adoption are

likely different from those that affect institutionalization of the technology in the same enterprise. This seems to indicate that a research approach on adoption of e-commerce by dividing the adoption process into two stages of initial adoption and institutionalization is very suitable within developing countries' context.

Therefore, it is important to understand how construction businesses in developing countries successfully institutionalize e-procurement. Hence, the purposes of this study are to:

- (1) Develop an underlying model of e-procurement adoption to identify the relevant organizational, environmental, technological, and managerial factors that affect decisions to initial adoption and institutionalization of e-procurement in construction sector in developing countries;
- (2) Develop a sufficiently validated measurement instrument to show the utility of the proposed model.

This study is one of very little studies on adoption of e-commerce under a process-oriented view of the adoption. It contributes the innovation adoption literature a specific focus on the post-adoption stage that the literature is limited. However, the developed model should be validated again through larger samples, especially by a multi-country study. This will increase the validation and the generalization of the model and instrument.

2 Initial Adoption vs. Institutionalization of e-Procurement

As we know, the technology of e-procurement includes many different forms or innovations, such as e-informing, e-tendering, e-awarding, e-catalog, e-invoicing, e-contracting, or e-payment, etc. Core procurement processes include supplier selection, order placement, order fulfillment, and payment and settlement [6]; and each of the e-procurement innovations can support specific procurement processes. For example, e-informing innovation helps to inform quotes of requirement, bid results, and related information electronically. E-catalog provides an electronic representation of information about products and/or services offered by an organization. E-payment involves the issuing of bills, payment and reconciliation of accounts and logging of credits and invoices between partners [6]. An enterprise or organization may adopt and implement only one or many the e-procurement innovations simultaneously into their organization. In order to make the aim of the study tractable, it

was instructive to distinguish between entry-level adoption and its extent:

Initial adoption of e-procurement:

An organization is considered to have adopted initially e-procurement if it has deployed only one or many of the e-procurement innovations for a part of their purchases, and using the static or interactive websites to make promotions and publish basic company information or receive queries, e-mail; and form entry from users.

Institutionalization of e-procurement:

An organization is considered to have institutionalized e-procurement if it has:

- Deployed generally one or many of the e-procurement innovations for almost their purchases (more than 50%) and most of the procurement processes can be conducted electronically.
- Innovations deployed have a good interoperability together, with existing IT systems, and with external e-infrastructure through transactive or integrated websites that connected to e-marketplaces.
- Innovations deployed are consistent with the business strategy, organizational structure, and social environment with the enterprise.

Fig.1 illustrated clearly our view of the adoption vs. institutionalization of e-procurement.

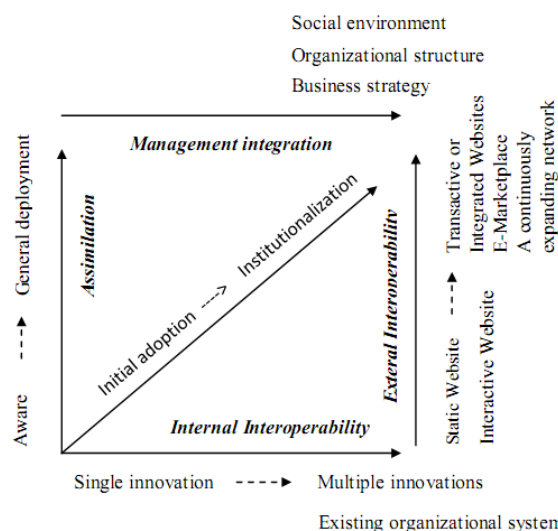


Fig.1 - Initial Adoption vs. Institutionalization of e-Procurement

3 Why Need a Specific Study on Institutionalization of e-Procurement?

Generally, the literature on adoption of e-commerce is relatively mature. However, there have still been many practical problems need to be explained. For instance, given the same the level of resources and the same operating environment, several firms have implemented more sophisticatedly e-procurement applications but others do not. In addition, several construction enterprises have adopted initially one or multiple simple e-procurement innovations for a long duration, and even though they have mature resources for e-commerce, but they did not conduct any subsequent implementation of the technology ([7], pg.98).

In attempt to identify/assess determinants of adoption of e-commerce technologies, previous empirical studies consider the adoption under a general view; as they posit generally decisions of early adoption and of its extent were influenced by the same factors. Examples were [10-12]. Furthermore, although based on a single or multi-perspective approach, these studies mainly took into account the specific attributes of the technology and the related characteristics of subject in which the technology will be applied (i.e. individuals, enterprises, industrial environment, countries) into their considerations. Very little empirical studies paid appropriately attention on the nature of adoption process, especially the difference between the initial adoption and its extents, such as "institutionalization". There have been only such three papers found. While [9] investigated factors influence on the initial adoption vs. institutionalization of e-commerce in developing countries, [13] focused on supplier's behavior on the post-adoption phase of B2B e-Reverse Auction in Greece, and [14] investigated determinants of initial adoption vs. post-adoption of e-business in retail industry. Literature acknowledges that e-business adoption is a complex and multi-phase process that heavily reliant on the provision of information and communication among individuals and groups [1]. To this, the process-oriented view argues that only examining the initial adoption of an innovation can not reveal the reach and richness of post-adoption activities [14]. Moreover, the Theory of Reasoned Action (TRA) [15] suggested that "performance or nonperformance of a specific behavior with respect to some object usually cannot be predicted from knowledge of the person's attitude *toward that object*. Instead, a specific behavior is viewed as determined by the person's *intention to perform that behavior*" (pg. 16). And it is not the potential adopters' *perceptions of an innovation itself*, but rather their *perceptions of using* the innovation that are key to whether the innovation diffuses (pg. 196). Based on these premises, open at the organization

level, the authors suggest that study on adoption of a new technology by an enterprise should consider both the characteristics of an innovation itself and the nature of adoption process of the innovation.

The most recent evidence suggests that adoption and diffusion of e-commerce can be better understood by breaking it down into two levels: entry-level adoption and its extent adoption or institutionalization [9; 13; 14]. "An enterprise's resources and awareness components do not arguably appear to be significant in affecting the maturity of e-commerce adoption...these factors are necessary but not sufficient after entry-level e-commerce adoption" [9]. The evidence indicates that determinants of initial adoption of e-commerce are very different from that of institutionalization in developing countries' context [9; 14].

In short, it can be said that studying specifically on institutionalization of e-procurement is not conducted much and it is a very necessary consideration for an understanding of the adoption and implementing successfully the technology. In order to fill this existing gap, the present paper is to develop a model and an instrument to investigate determinants of initial adoption and institutionalization of e-procurement in construction industry in developing countries.

4 Theoretical Background

First, we begin from the literature of general innovation adoption. Theories of the adoption of innovation promote four dominant perspectives, including managerial imperative, organizational imperative, technological imperative, and environmental imperative. The technological imperative considers the complexity, compatibility, relative advantage, ease of use, usefulness, and other attributes as key drivers of adoption. The theory of diffusion of innovation (DOI) [16] and the theory of technology acceptance (TAM) [17] are two main theories in this perspective. Managerial imperative seeks to explain innovation adoption based on the innovativeness attributes of managers, their commitment to the innovation and IT background [18]. Organizational imperative assert that the internal context of an organization brings most the key determinants of adoption. They consider specification, functional differentiation, formalization, centralization, readiness, risk-taking propensity, and innovativeness as major impact factors to the adoption [19]. Environmental imperative focuses on external factor, such as government commitment, legal system, pressure of competitors, requirement of partners, institutional

forces, and socio-economic factors; considers them as major determinants of adoption of an innovation (e.g. [20], [21]). Institutional theory [22], the Theory of Planned Behavior, TPB (Ajzen, 1985), and the Theory of Reasoned Action (TRA) [15] are important theories of this imperative. Many studies used an interactionism approach that combines multiple mentioned imperatives (e.g. [23]).

Literature of e-commerce adoption also shows that e-commerce adoption is significantly impacted by technological, organizational, environmental, and managerial factors. Many of these studies were based on the interactionism approach that considers all four mentioned perspectives and their interaction in one dynamic and unified framework (e.g. [9; 10; 14; 24]). It can suggest why an innovation is successful in a given organization while other innovations are not as well as while a certain firm adopts successfully a specific technology while others do not. Towards the interactionism approach, previous studies most frequently used the Technology-Organization-Environment (TOE) framework that developed by [19], and the Unified Theory of Acceptance and Use of Technology, UTAUT that developed by [25]. In my present study, e-procurement adoption will be analyzed on the interactionism approach with two theoretical foundations: (1) the TOE framework and (2) the Theory of Reasoned Actions (TRA).

The Extended TOE Framework

A review of the literature reveals the explanatory power of the Technology, Organization, and Environment (TOE) framework that is based on the interactionism perspective. The TOE framework identifies three aspects of a firm's context that may co-influence on the adoption process of an innovation [19]. They include (1) environmental context in which a firm operates (related to its industry, competitors, partners, customers, and government), (2) organizational context that refers to characteristics of an organization (e.g. scope, size, resources), and (3) technological context that describes both the existing and new technologies relevant to the firm. Generally, previous empirical studies have confirmed the value of this framework in studying on adoption of Internet-based technologies, such as e-commerce [10; 14; 24].

As discussed earlier, since business culture and managerial style of Vietnamese managers is unique and very different from that of managers in developed economy, the managerial context (i.e. managers' characteristics, innovativeness, knowledge of IT) needs to be paid attention in studying on adoption of e-commerce technologies. Therefore, in this present study, the author will use

the extended-TOE framework, which includes additionally the managerial context, to study e-procurement adoption in the Vietnamese context. In other words, the author posited managerial, organizational, environmental, and technological issues together could provide a meaningful predictor of e-procurement initial adoption and institutionalization in construction companies in developing countries.

The Theory of Reasoned Action (TRA)

The Theory of Reasoned Action (TRA) is developed in an attempt to explain individuals' behaviour through the impact of attitude [15]. According to TRA, the most important determinant of an individual's behavior is behavioural intentions. Intention is an indicator of a person's readiness to perform certain behavior and it is considered to be the immediate antecedent of behavior [15]. In turn, behavioural intentions are mainly influenced by personal or attitudinal factors and social or normative factors. Furthermore, also according to the TRA, a specific behavior with respect to a certain object is usually viewed as determined by the person's attitudes and subjective norms related to performance of that behavior rather than by the person's attitudes toward that object itself. Based on these premises, at the organizational level, the authors posit two points: (1) Instead of investigating determinants of decision-making of e-procurement adoption, we should investigate determinants of an enterprise' intention to adopt e-procurement. (2) Instead of an enterprise's attitudes toward, and subjective norms concerning, e-procurement itself, their attitudes toward, and subjective norms concerning, adopting e-procurement are considered as key determinants of a decision of institutionalization of the technology.

It should be noted that it can be said that most, if not all, businesses in developing countries tend to have a highly centralized structure [26]. Additionally, perceptions influence attitudes, behavioral intentions, and the actual behavior of individuals [15]. Therefore, the perception of the managers about their organization, innovation, and their operating environment is very critical in decision making of implementation of e-procurement. Here, we proposed the concept of "perceived supports" to represent managers' assessments of the environmental, organizational, managerial, and technological contexts in making decisions about institutionalizing e-procurement.

In order to make the model parsimonious, the author has identified four constructs as the following: *Perceived Environmental Supports (PES)* represents supports from relevant external

environment factors (e.g. government commitment, legal system, IT infrastructure, etc.) that could negatively or positively affects to e-procurement adoption into their business. *Perceived Organizational Supports (POS)* represents supports related organizational factors (e.g. structure, culture, resources, IT systems, business strategy, commitments, external business relationships, etc.) that could support for their decisions of adoption of e-procurement into their business. *Perceived Managerial Supports (PMS)* represents supports related organizational factors (e.g. top managers' perceptions, awareness, leadership style, changes management ability, etc.) *Perceived Technological Supports (PTS)* represents top manager's positive attitudes towards, and positive subjective norms concerning to, the adoption of e-procurement. Take together PES, POS, PMS, and PTS are hypothesized to predict well e-procurement adoption in construction companies in developing countries. Fig.2 captures the structure of the conceptual framework.

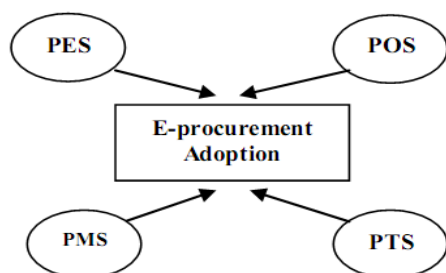


Fig.2 - The conceptual framework of e-Procurement adoption

5 Research Methodology

5.1 Strategy

In order to ensure the accuracy and validity of the instrument and to reduce the measurement error, the development of an instrument needs to focus on two following issues. *Developing the structural model:* like the most of previous studies on determinants of adoption of innovations, the development of structural models is based on the theoretical ground of developed theories and the experience from existing related literature (e.g. [26; 27]). *Developing the measurement model:* In this study, both formative and reflective indicator specifications are used to model the latent constructs in the proposed model. In order to develop indicators of formative constructs, the authors follow the method proposed by [28] that includes content specification and indicator specification. While the interpretation of

formative measurement results is based on the procedure proposed by [29], including (1) the examination of multicollinearity, (2) the number of indicators, (3) the possible co-occurrence of negative and positive indicator weights, (4) the absolute vs. relative contributions made by a formative indicator, and finally (5) the nomological network effects.

5.2 Specify domain of content of latent constructs in the structural model

In order to develop an accurate and content valid instrument, the specification of the scope of the latent variable is particularly important because a formative construct is more abstract and ambiguous than a reflective construct. Additionally, since a formatively measured variable is determined by its indicators rather than vice versa, thus an exclusion of a relevant indicator will exclude a certain part of the construct itself. In other words, the development of indicators for a formative construct needs to consider all facets of the construct. Three approaches and a related literature review were used in identifying the theoretical constructs of the model.

First, the resource-based view argues that firms possess resources, a subset of which enables them to achieve competitive advantage, and a further subset which leads to superior long-term performance ([30] cited). The theory provides a valuable way for Information Systems researchers to think about how information systems are related to firm strategy and performance. In particular, it brings a solid framework to evaluate the strategic value of IS resources. It also provides guidance on how to differentiate among various types of IS, and how to study their influences on performance. Furthermore, the theory provides a basis for comparison between IS and non-IS resources, and thus can facilitate cross-function research [30]. Based on a typology of IS resources developed by [30], the author defined the major construct of *Perceived Organizational Supports (POS)* as the degree to which managers believed that their enterprise's internal organizational characteristics and external business characteristics are supportive and incentive in adopting e-procurement. The major construct of *Perceived Managerial Supports (PMS)* is defined as the degree to which managers believed that their top managers' perception and ability, and leadership style are supportive and incentive in adopting e-procurement.

The theory of competitive context analysis is an approach that focuses on the national circumstances. It provides a framework to analyze the role and

importance of national factors that define the operating environment of the enterprises. In this, demand conditions, related and supporting industries, and government are some of the key attributes of the national circumstance. Based on this theory, the authors defined the major construct of *Perceived Environmental Supports (PES)* as the degree to which managers believed that government leadership infrastructure, legal and regulation infrastructure, information technology and other supporting industries infrastructure, and socio-economic and knowledge infrastructure were ready to support their organization in institutionalizing e-procurement. The descriptions of these three sub-constructs are shown in Appendix A.

As discussed earlier in the section “theoretical background”, based on the TRA [15], the major construct of *Perceived Technological Supports (PTS)* is defined as the degree to which managers believed that top managers’ attitudes towards, and subjective norms concerning to, adoption of e-procurement are positive enough to support making an adoption decision. In addition, the TRA also supposes that a person’s attitude towards a given behavior is affected by some of the relevant beliefs, which are concerned with the behavior itself, and is related to his beliefs that performing the behavior will lead to certain consequences and his evaluation of those consequences. A person’s subjective norm is the totality of the normative pressures, which is made by normative beliefs or beliefs of a normative nature, i.e. beliefs that certain referents think the person should or should not perform the behavior in question [15]. Based on these ideas, Appendix A showed the descriptions of two constructs of PTS.

A related literature review was also conducted to gain a more comprehensive look. Their arguments, findings, and implications provide empirical foundations in developing the structural model. Appendix A showed these studies’ contributions in detail. Based on the approaches mentioned and the literature review, we have a framework for an investigation of the multiple-imperative variables that might affect e-procurement adoption decisions in construction industry in developing countries.

The dependent variable is adoption of e-procurement. As we know, adoption of e-commerce is a progressive, multiphase, complex process. In this study, for better understanding of the adoption, the author pays specific attention on two key variables: initial adoption and institutionalization propensity. The focuses are motivated by the process-oriented view about the adoption, use, and benefits from IT innovations [14]. Accordingly, merely examining the initial adoption cannot understand well decision-making of post-adoption.

Initial adoption of e-procurement is an early stage of the adoption process of e-procurement, at which enterprises only implement e-procurement innovations at the sample degree. The institutionalization of e-procurement is a post-adoption stage of the adoption process, at which enterprises implement sophisticatedly the technology into their business in terms of management, functions, and usage. Institutionalization propensity (or intention) of e-procurement is defined as an indicator of an enterprise’s readiness to institutionalize e-procurement. It is worth noting again that I presently investigate determinants of institutionalization propensity rather than that of the institutionalization itself. This is based on the basic of the TRA as it supposes, “the most important determinant of an individual’s behavior is behavioural intentions. Intention is an indicator of a person’s readiness to perform certain behavior and it is considered to be the immediate antecedent of behavior [15]. This point was discussed in the section “theoretical background”. Based on the definitions of initial adoption and institutionalization of e-procurement were discussed and presented in section 2, Appendix A presents descriptions of initial adoption and institutionalization propensity. Fig.3 showed a conceptual framework for an investigation of the multiple-imperative variables that might affect e-procurement adoption decisions in construction industry in developing countries.

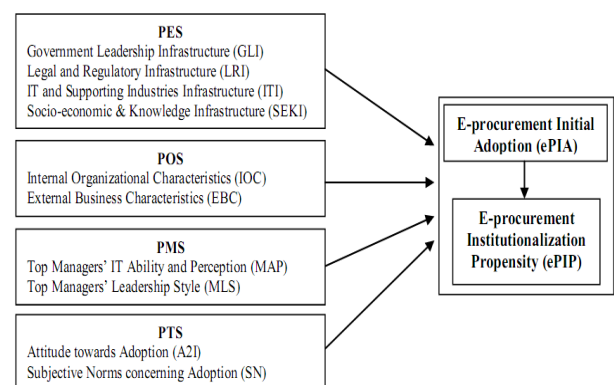


Fig.3 – The conceptual research model of adoption of e-Procurement

5.3 Indicator specification

For formatively measured variables, the items used as indicators must cover the entire scope of the latent variables as described under the content

specification (presented in Appendix A). This means that the indicator specification stage to be sufficiently inclusive in order to capture fully the construct's domain of content; the exclusion of indicators is, however, still possible. First, based on an existing extensive literature on e-procurement, e-commerce, and Information Systems, the set of 55 measurement items for all the independent/dependent constructs of the proposed models are collected. Next, two professors from Hohai University with experience in survey development were involved to assess the general structure of the instrument. Then three Vietnamese e-commerce experts refined and edited the instrument to further ensure its content validity (i.e. content, scope, and purpose). Finally, the initial instrument with 49 items was gained and showed in detail as Appendix B. Information of the structural model was shown in Table 1.

6 Data Collection

6.1 Data collection strategy

To test the conceptual model in Fig.3 and the associated hypotheses above, we need to conduct a questionnaire survey to collect data. Here, the questionnaire was designed merely on the basis of a comprehensive literature review of e-commerce and was refined via several pretests, revisions, and pilot tests. Each of the items on the questionnaire was reviewed by an expert panel, which consists of two professors from Hohai University and three Vietnamese e-commerce developers, for its content validity (i.e. content, scope, and purpose). After the

questionnaire was finalized, it was translated into Vietnamese language. Then the survey was executed in Hanoi, Vietnam. Hanoi has been selected because it is the country's capital, is a economic and political center in which many construction companies have been using simple e-procurement innovations at the initial adoption level (e.g. e-mail, e-informing, e-tendering, etc.) [31], [32]. In addition, the operation of a public e-procurement system, which has been recently established and managed by Government, could potentially have the big impact on the e-procurement state in the recent future. This makes Hanoi an appropriate place for our research.

Since it is often that surveys by self-administered questionnaire via post or e-mail in Vietnam gain a very low response rate, we used questionnaire survey administered in person in this research program. The survey was performed in two stages. The stage 1 consists of two wages, including (1) a proposal letter and the questionnaire were e-mailed by the VINAVICO Construction Consultant and Investment Company in Hanoi to introduce the research project, and then (2) calls were conducted directly to firms to making an appointment (date and time) one week later. In stage 2, professional staffs of VINAVICO visited each enterprise and administered the questionnaire in person.

The sampling procedure involved a number of stages. First, based on a set of operational criteria, including the characteristics of the population, the comprehensiveness of the list, and its completeness in terms of contact addresses, such as the name of the top executive, a Hanoi construction business yellow-page at <http://yellowpages.vnn.vn/> was identified as a sampling frame.

Table 1 - Information of the proposed conceptual model

Latent Variables	Type	Manifest variables
Supports from Government Leadership Infrastructure (GLI)	Formative	GLI1 to GLI4
Supports from Socio-economic and Knowledge Infrastructure (SEKI)	Formative	SEKI1 to SEKI4
Supports from IT and Supporting Industries Infrastructure (ITSI)	Formative	ITSI1 to ITSI8
Supports from Legal and Regulatory Infrastructure (LRI)	Formative	LRI1 to LRI4
Supports from Top managers' Characteristics (MC)	Formative	MC1 to MC7
Supports from Internal Organizational Characteristics (IOC)	Formative	IOC1 to IOC5
Supports from External Business Characteristics (EBC)	Formative	EBC1 to EBC4
Positive Attitude towards the Institutionalization of e-procurement (A2I)	Formative	A2I1 to A2I3
Positive Subjective Norm related to the Institutionalization (SN)	Formative	SN1 to SN3
E-procurement Institutionalization Propensity (ePI)	Reflective	ePI1 to ePI5
E-procurement Initial Adoption (ePIA)	Reflective	ePIA1 & ePIA2
A total number of items		49

Ideally, the larger sample size increase the power of tests, but this is often constrained by operational limitations. In the proposed model, the construct with the largest number of formative indicators is IOC with five items and the number of independent latent variables is nine. According to a rule of thumb used in PLS-SEM [33], the minimum sample size required is 90 samples. By a questionnaire survey administered in person, the authors hope a response rate is about 50%. Therefore, in order to obtain a minimum required returned-sample size of 90-100, a total of 200 businesses were selected from the sample frame using a systematic random sampling procedure (every n item). Thus, generally, the author believes that our sample reflects the status of e-commerce in the industry across Hanoi.

In order to address the problem of consistency motif, the questions measuring the independent constructs were placed before the question measuring the dependent variable. The statements are designed that a response of strongly agreement will generate the highest score of 5 points in the five-point Likert scale. Respondents were key leaders who understand in depth and clearly about their enterprise as well as external context in the domain of IT and procurement activities, such as senior managers, procurement office's managers, IT managers, and marketing office's managers to provide valid and suitable data.

6.2 Response rate and profile of respondents and respondents' organizations

After surveys conducted in May, July, and September 2012, 115 responses were collected. We had to collect data via three surveys because of objective reasons. The sample frame of the later survey excludes businesses that were surveyed in the first survey. The author checked the sample for consistency and dropped invalid responses, resulting in a final dataset of 112 valid cases. The response rate is 56%. Of 112 responses, four were from senior managers; sixty-one were from procurement office's managers; thirty-two were from marketing office's managers; and fifteen were from IT managers. Five of them have Ph.D. degrees; fifty-seven of respondents have a Master degree; and the remaining respondents have Bachelor degrees. A majority of respondents (about 80%) have at least 5 years of experience in the construction industry. Considering the profile of the respondents and their enterprises, it can be said that the responses can be confidently relied upon. There have been thirty-eight construction contractors, fifty-four engineering and architectural design consultants, and twenty suppliers represent 34%, 48%, and 18% of the total

of responses respectively. Most enterprises (97%) have the number of year of operation greater than 5 years. In detail, 45 firms are operating in building works (40%), 60 firms are operating in both building and civil areas (53%), remaining ones are operating in other areas.

Firm size was categorized based on the number of employees. The business law in Vietnam defines that an enterprise is considered as a small and medium enterprise (SME) if it holds capital of not more than VND 10 billion (equivalently 500.000\$) or the annual average number of labor of not more than 300 people [10]. Firm size was categorized based on the number of employees. The sample consists of 97 of SMEs (83%) (the annual average number of labor is less than 300 people) and 14 of large firms (17%), this also reflects well the current industrial structure in Hanoi. In the sample, 57 enterprises have no websites, 55 remaining ones have static or interactive websites. The authors examined the dataset for potential biases and found no significant biases between groups of respondents of three surveys in terms of firm size and business sectors.

7 Analytical Approach and the Results

7.1 PLS analysis

To empirically assess the constructs theorized above, the authors conducted CFA using structural equation modeling (SEM) as implemented in partial least squares (PLS) by Smart-PLS 2.0 M3 software. The results were showed as in Fig.4. The author used PLS-SEM to conduct analysis of the model since it is generally more suitable for studies in which the objective is prediction; the phenomenon under study is new or changing; the model is relatively complex (i.e., large number of manifest and latent variables); formative constructs are included in the conceptual framework [34]. Moreover, this method is suitable for the data, which does not satisfy the assumptions of (multivariate) normality, large sample size, and independence.

Basically, the proposed reflective constructs met a three-measure rule of [35] that defines that a reflective measurement model should have at least three indicators. These formative constructs also met a necessary condition for identification of a formative construct [29] that defines that each formative construct should emit more than one path to reflective constructs.

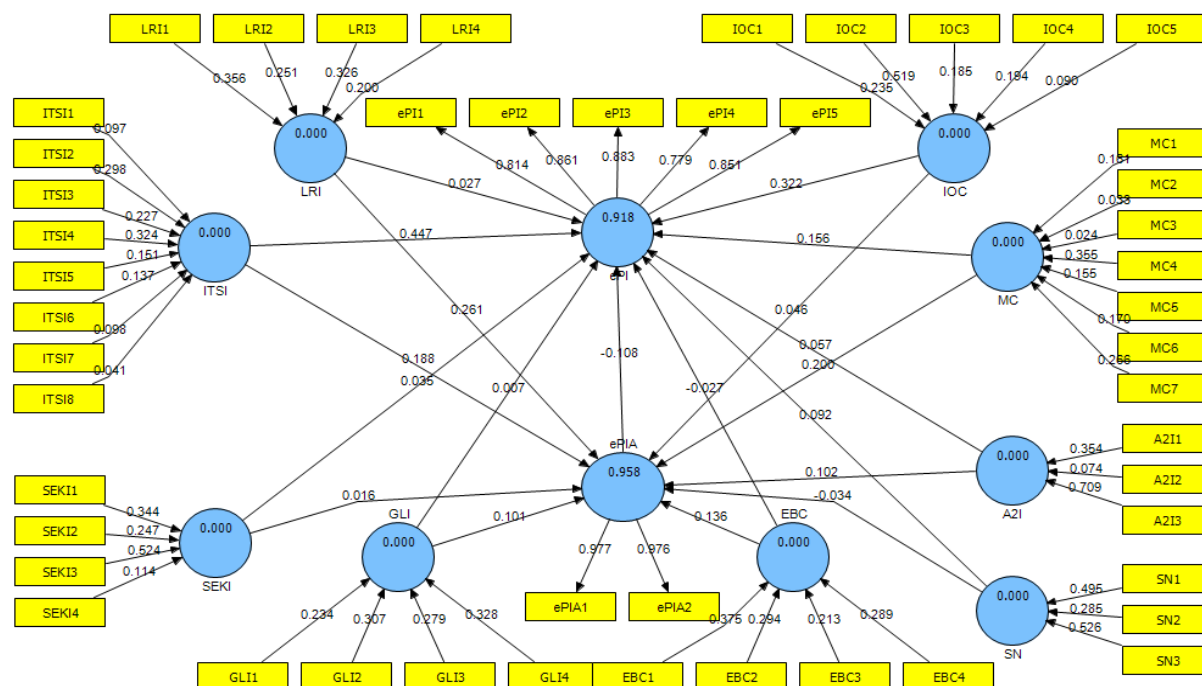


Fig.4 – Illustrates a research model (by Smart-PLS 3.0)

7.2 Results

For reflectively measured constructs, the author conducts tests of individual item reliability, convergent validity, and discriminant validity. For formatively measured variables, followed the interpreting method of formative measurement proposed by [29], the author conducted tests of multicollinearity of the indicators, assess the formative indicators' weights and loadings, and nomological validity. Finally, the predictive validity of the structural model is tested.

7.2.1 Individual item reliability analysis

Two reflective constructs, ePI and ePIA, were accessed the individual item reliability by the standardized loadings. Many researchers accept items with loadings of 0.7 or more, which indicates that there is more shared variance between the latent variables and its measures than error variance. Based on the output of Smart-PLS 2.0 M3, all items of ePI and ePIA have loadings greater than the cutoff point of 0.70 (see Fig.4). It implies that less than half of all items variance are due to error. Thus, all the items demonstrate satisfactory level of individual item reliability.

7.2.2 Convergent validity

Convergent validity is the measure of the internal consistency of items. Two reflective latent constructs of ePI and ePIA were accessed the convergent validity. In PLS, we have two tests can be used to determine the convergent validity of the measured constructs, including Cronbach's alpha or composite reliability, and average variance extracted (AVE). Reference [36] cited that a benchmark of 0.7 for composite reliability, 0.6 for Cronbach's alpha, and 0.5 for AVE. In this study, these indexes were gained by Smart-PLS 2.0 M3 and SPSS, and are presented in Table 2. These results demonstrate that there is convergent validity and good internal consistency in the measurement model. This implies that the measurement items of each latent variable measures them well and are not measuring another latent variable in the research mode.

Table 2- AVE, Composite Reliability, and Cronbach's Alpha

	AVE	Composite Reliability	Cronbachs Alpha
ePIA	0.9538	0.9763	0.9515
ePI	0.7030	0.9219	0.8940

7.2.3 Discriminant validity

Next step, the author carries out assessment of the discriminant validity of the measurement. Discriminant validity implies the extent to which a given latent variable is different from other latent variables in the model. Two reflective latent

constructs of ePI and ePIA were accessed by this test. At the indicator level, the discriminant validity is accessed by an analysis of cross-loadings. This analysis was conducted by following the rule is that items should have a higher correlation with their respective measured variable than with any other latent variable in the model. As the output of Smart-PLS 2.0 M3, the cross loadings of constructs was presented in Table 3.

Table 3 - The cross loadings of constructs

	ePI	ePIA
ePI1	0.816	0.764
ePI2	0.861	0.808
ePI3	0.883	0.853
ePI4	0.777	0.657
ePI5	0.880	0.745
ePIA1	0.895	0.977
ePIA2	0.897	0.976

At construct level, the discriminant validity is accessed by an analysis of average variance extracted (AVE). The discriminant validity is adequate when the variance shared between a construct with any other construct in the model is less than the variance that the construct shared with its indicators. [36] cited the rule is that the square root of AVE of each latent variable should be greater than the correlation of two latent constructs. This rule is demonstrated in the correlation matrix for the latent factors, as shown in Table 4. The diagonal of the matrix is the square root of AVE; and for adequate discriminant validity, the diagonal elements should be greater than the off-diagonal elements in the corresponding rows and columns. The results show there was no correlation between any two latent variables larger than or even equal to the square root AVEs of the two latent variables. Hence, discriminant validity test does not reveal any serious problem.

At this point, there is sufficient evidence of both convergent and divergent validity and therefore the instrument can be considered to generate quality data to measure reflectively latent variables. In next sections, we assess tests of formative indicators.

Table 4 - The correlation of constructs and the square root of AVE

	ePI	ePIA
ePI	0.838	
ePIA	0.817	0.977

Legend: Bolded diagonal are the square root of AVE

7.2.4 Test multicollinearity of the formative indicators

Assessing the degree of multicollinearity among formative indicators is an important step in formative construct validation. The greater the level of multicollinearity among the indicators, the more likely the indicators will have low or non-significant path weights [29]. If measures are highly correlated, it may suggest that multiple indicators are tapping into the same aspect of the construct [37]. In order to check for multicollinearity, variance inflation factor (VIF) was calculated [37]. The general statistical theory suggests that multicollinearity is a concern if the VIF is higher than 10; however, with formative measures, multicollinearity poses more of a problem. If the VIF statistic for formative measures is greater than 3.3 [38], we should use one of the approaches outlined in [37] and [29] to address the issue. In this study, SPSS program was used to obtain VIF scores. A few of VIF scores of the items (ITS12 and MC5, see Appendix C) are greater than the suggested threshold of 3.3. According to [29], we determined if there is any conceptual overlap between the chosen indicators. A reading of the wording of the indicators suggests no major overlap and therefore, no need at this point to decide to remove any indicator.

7.2.5 Assess the formative indicators' weights and loadings

To assess the formative indicators' weights, a bootstrap analysis was performed with 200 subsamples and path coefficients were re-estimated using each of these samples. Results are presented in Appendix C. It is worth noting that the weights of formative indicators provide the unique importance of each indicator by partializing the variance of criterion that is predicted by the other indicators. The loading of the indicator and so its bivariate correlation with the formatively measured construct provides the absolute importance of an indicator to its construct [29]. There have not been minimum threshold values for formative indicator weights have been established and a high indicator weight suggests that the indicator is making a substantive contribution to the formative construct [38]. While formative indicator weights are important for determining their "relative" contribution to their respective construct; the weights are not the only criteria for retaining or omitting an indicator from a formative model [29]. An indicator with a low or non-significant weight may still have an important

absolute contribution if the indicator is assessed independently from the other indicators [29].

In our model, there are five indicators, which have statistically non-significant weights (italic in Appendix C). The number of indicators or the collinearity has important implication for the statistical significance and the magnitude of each indicator's weight in formative measures. A large number of indicators will result in a greater likelihood that many of the indicator weights will be low in magnitude as well as statistically non-significant. In the construct of SEKI, the indicator of SEKI 4 has low and non-significant weight (weight = 0.11, $t = 1.1$). Obviously, the collinearity and the small number of the indicators of SEKI have been ruled out as causes of low indicator weights. A reading of the wording of the indicators suggests there is a conceptual overlap. The item of SEKI4 seems to be reflected through the items of SEKI2 and SEKI3. Additionally, SEKI4 has a quietly low loading of 0.41. This means that SEKI 4 is not absolutely as well as relatively important. Thus, removing the item of SEKI4 should be considered.

In the ITSI construct, two items of ITSI7 and ITSI8 have low and non-significant weights; all of them, however, have positive, high and significant loadings. It can be said that the problems are facing in the construct of ITSI are very likely results from the existing simultaneously both multi-collinearity and a large number (8 items) of the indicators in the ITSI construct. By analyzing causes, we found that the construct of ITSI should be divided into two separate latent constructs. The indicators of ITSI1, ITSI2, ITSI3, ITSI4, and ITSI5 may fall into a construct of IT infrastructure (called ITI), which refers to factors related to Information and Technology. While the indicators of ITSI6, ITSI7, and ITSI8 may measure another construct of supporting industries infrastructure (called SII), which refers to factors related to supporting industries, such as finance system, transportation, or telecommunication.

In the MC construct, there are two measures with low and non-significant weights but high and significant loadings. After considering all prescriptions for interpreting a formatively measured construct proposed by [29]; grouping the indicators of MC into two or more distinct constructs with separate effects on theoretically relevant outcomes may be a best approach. A reading of the wording of the indicators suggests there is a conceptual overlap. The construct of MC should be divided into two separate latent constructs, include top managers' ability and perception (called MAP) which should be measured by MC1, MC2, MC3, and MC4; and top managers' leadership style

(called MLS) which should be measured by MC5, MC6, and MC7. Therefore, the initial model should be modified following the above mentions. Appendix B illustrates the new version of the proposed model.

7.2.6 Assess again the formative indicators' weights and loadings within the new version of the model

In the new version model, there are no indicators with statistically non-significant weights; and all indicators have significant and high loadings within the range of 0.63 – 0.96 (except A2I2). Thus, it can be said that the model's formative constructs were, generally, specified well. According to [29], we, next, conduct testing the nomological network effects with the new version model.

7.2.7 Nomological network effects

According to [29], construct portability is important issue of formative measurement interpretation: the relative invariance of a construct's indicator weights as the construct is used in different nomological networks. With the estimation of a formative variable depends on other constructs in the model, some degree of change in indicator weights is expected. However, a large change implies a shortage of portability and so negatively influences the generalization of the interpretation of a given indicator's contribution and so also the results of the model [29]. Such validation is particularly relevant when indicators have been eliminated from the original constructs; in this case, it becomes essential to establish a new version model. This validation approach requires (1) that information is gathered for at least one more construct than the one captured by the indicators, (2) that this other construct must be measured reflectively, and (3) that a theoretical relationship is necessary between these constructs [28]. With the new version model, the author changed its nomological network by removing one of the endogenous constructs ("e-procurement initial adoption" (ePIA) and replaced it with a different reflectively measured construct (an enterprise's attitudes towards e-procurement (ATP)). The new construct was measured by two last statements in the Questionnaire ("I think our enterprise considers e-procurement is as a long-term strategic rather than a short-term operational decision." and "I think that our enterprise considers e-procurement is one of the most important strategies for the development of our enterprise" as in Appendix E). It can be said that ePIA and ATP are positively correlated. The revised model is analyzed with PLS (Appendix E) shows

that there is no large change to the relative magnitudes of the indicator weights. Therefore, the construct portability of the model is adopted.

7.2.8 Predictive validity of the structural model

Based on the results, the measurement model has good individual item reliability, convergent validity, discriminant validity (for reflectively measured constructs), and has good multicollinearity, weights and loadings, and nomological network effects (for formatively measured constructs). Therefore, the measurement model demonstrates sufficient robustness needed to test the relationship among the latent variables and the dependent variables. With satisfactory robustness of the measurement model, the structural model is assessed next to determine the explanatory power of the model. This test is assessed by examining the amount of variance in the dependent variable that can be explained by the model. Smart-PLS 3.0 provided the squared multi correlations (R^2) for two dependent variables in a model. In this study, the R^2 for “initial adoption” and “institutionalization” are 0.92 and 0.96 respectively (in Appendix D) meaning that about 92% and 96% of the changes in the entry-level adoption and institutionalization of e-procurement in construction firms in developing countries is due to the eleven latent variables in the model.

Now, it can be summarized that the modified model and its instrument are sufficiently valid to explain adoption of e-procurement.

8 The Final Model of e-Procurement Adoption

The final model of e-procurement adoption is shown as Fig.5 with its instrument in Appendix F. It represents progress towards identification, measurement, operationalization, and validation of environmental, organizational, managerial, and psychological variables that affect e-procurement adoption in construction industry in developing countries.

8.1 A preliminary test of the model

The model was tested using data collected in Hanoi. We used the bootstrap function in Smart-PLS 2.0 M3 with 200 resample to assess the validation of the model. The hypotheses are considered with the conventional significant level of 0.05 (a one-tail t-test). There are ten out of the twenty-three paths are

statistically significant. Analysis and interpretation of the findings have led us to the following conclusions about e-procurement adoption in construction firms. (1) In developing countries' context, the role of government is critical to push individual construction enterprises towards the entry-level adoption of e-procurement; this role appears through clear and comprehensive commitment, well-defined legal systems, e-Government initiates, specific supporting policies and incentives to SMEs, and improved institutional information resource. (2) Supports of government are less influential than organizational factors on a decision of institutionalization of e-procurement in construction firms. Meanwhile, the suitability between the innovation and business model and strategy, and top managers' change management ability emerged as two decisive factors of decision-making of e-procurement sophistication. (3) Psychological factor influences significantly on decision of e-procurement institutionalization in developing countries. Perceived pressures and desires from an enterprise' important referents (i.e. government, competitors, partners, customers) on e-procurement sophistication seem to foster the enterprise institutionalize e-procurement. This finding can help us to explain partly the argument is that given the same the level of organizational resources and operating environment, why several firms have implemented more sophisticatedly e-procurement innovations while others do not. (4) Finally, experience of the initial adoption of e-procurement does not have any significant effect on a decision of subsequent implementation of the technology. This finding helped us to explain partly an existing fact is that among adopters of e-procurement within the same operating environment, some firms have implemented e-procurement at the more sophisticated level while others do not.

9 Implications and Conclusions

As a part of a research project on adoption of e-procurement in construction industry in developing countries' context, this paper is pursued to theoretically construct and empirically test a model and an instrument to investigate the determinants of initial adoption and institutionalization of e-procurement. Consequently, it presented an in-depth discussion on the nature of adoption process of an innovation in an organization and a specific focus on initial adoption vs. institutionalization of e-procurement.

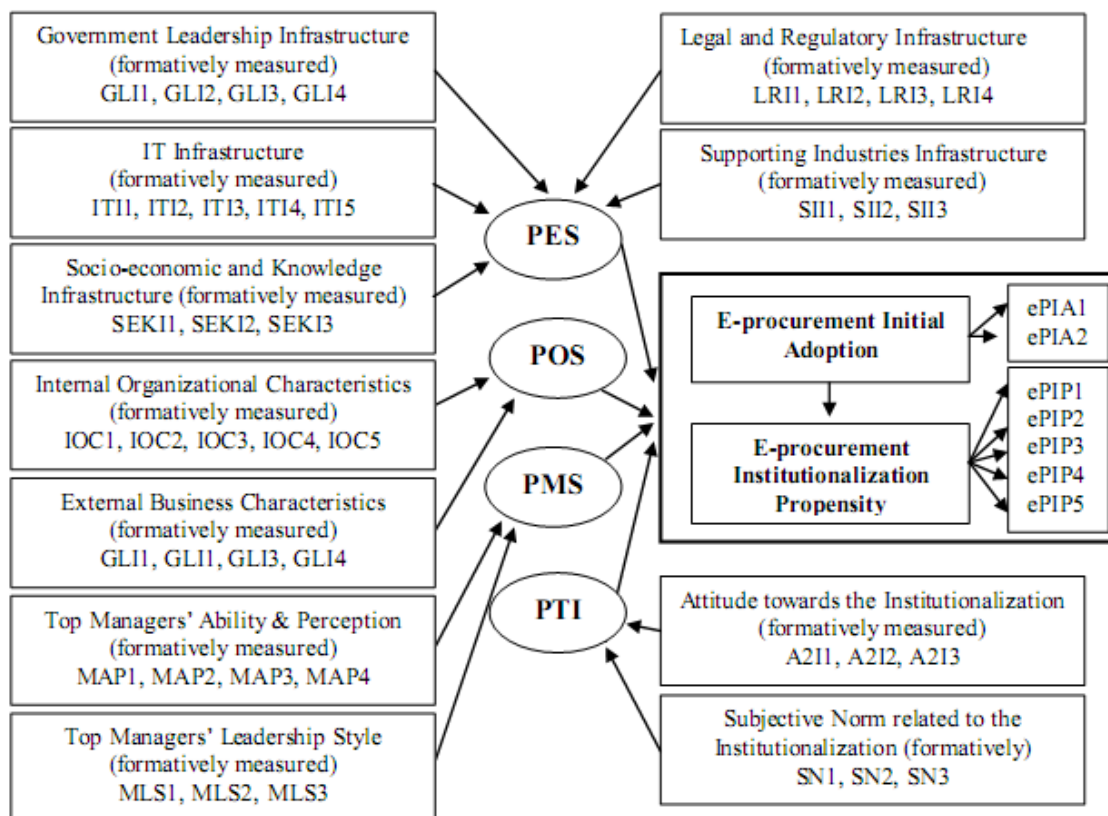


Fig.5 - The model for assessing the adoption of e-procurement

Based on the literature review of adoption of innovation, the paper posited that the organizational, environmental, and technological factors together predict well a decision of initial adoption and institutionalization of e-procurement in construction companies. The paper used four theories, including the TOE framework, the theory of resource-based view, the theory of competitive context analysis [39], and the theory of Reasoned Action (TRA) [15] as the theoretical roots to develop the model.

It is, here, worth noting that the view of considering the multiple imperative determinants of adoption of an innovation is not new. However, *the novelty or values of this study* are the followings: (1) A focus on the organizational learning nature of adoption process of an innovation that has been not paid appropriately attention by the existing literature on adoption of e-commerce in general. A given organization, after reaching a certain degree of implementation of e-procurement, it can toward to keeping the current state or implementing the technology more sophisticatedly, or narrowing the degree of usage, even giving up the technology. This study focused attention on the difference between initial adoption and institutionalization of e-procurement. Obviously, a study as this present work is a necessary consideration for understanding

comprehensively the adoption of e-procurement. (2) The instrument developed covered industrial specific considerations of construction industry via two independent latent constructs: "Socio-economic and Knowledge infrastructure in the industry" and "External Business Characteristics." This solves the common limitation of existing related literature is that they did not bring industrial specific aspects into research models (e.g. [26]). (3) A focus of the investigation to both what the top managers perceive of their internal and external environment as well as what they might think of themselves and their IT knowledge. (4) Finally, another theoretical novelty of the present study is that it considers the technological imperative factors under a very different view from previous studies. Existing literature used a very wide range of different constructs to represent the influential role of the innovation on an adoption decision, such as perceived benefits, perceived challenges (trust, security, cost, etc.), perceived uncertainty, relative advantage, complexity, compatibility, perceived usefulness, ease of use, and so on. These constructs all are of natural characteristics related directly to innovation itself. However, in fact it is not the potential adopters' *perceptions of an innovation itself*, but rather their *perceptions of using the*

innovation that are key to whether the innovation adopted [15; 40]. So “innovation-natural” constructs proposed previously seems not to be the best suitable predictors to adoption of an innovation, especially a specific level of the adoption. Instead of them, in the present paper, the authors proposed two constructs that focus on the “using” of an innovation to represent the technological-imperative factors to predict a decision of institutionalization of e-procurement. The first construct is top managers’ attitude towards institutionalization of e-procurement; it reflects the perceived consequences of institutionalizing e-procurement. The second construct is top managers’ subjective norm related to institutionalization of e-procurement; it is their perception that most relevant referents who are important to their enterprise (e.g. government, partners, competitors, and customers) think their enterprise should institutionalize e-procurement.

Government or its related departments can use this instrument to understand and locate important factors influencing e-procurement institutionalization in individual enterprises in developing countries. Then they can make management solutions (via legal defines and policies) to improve the national environment that encourage individual enterprises (both private and

public) towards adopting/implementing e-procurement at a more sophisticated level of integration to which full advantages of the technology to potentially gain. Business managers could use this instrument to reflect inwards to access their internal organization and outwards to access the external environment and create an effective resource-development plan to overcome both internal vs. external limitations towards the institutionalization of e-procurement.

Finally, despite the steps undertaken to validate the model and ensure its reliability, the model should be validated again through larger samples, especially by a multi-country study. This will increase the validation and the generalization of the model and instrument.

Acknowledgments

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Appendix A - Descriptions of constructs of the proposed model

Variables	Description	References
<i>Perceived Organizational Support (POS)</i>		
Internal Organizational Characteristics	Represents the internal organizational issues distinguish an organization with others, include five facets: managerial resources (e.g. top manager commitment); business resources (e.g. business model and strategy flexibility); human resources (e.g. technology skills, organizational culture); IT resource (e.g. almost information is processed electronically), and organizational integration (e.g. structure flexibility).	[30]; [19]; [41]; [42]; [26]; [43]
External Business Characteristics	Refers to the external factors related to an enterprise's business activities; include four following facets: business-operating scope (i.e. international vs. domestic), main business trend of operating environment, e-procurement state of competitors and partners, and integration in supply chain.	[30]; [14; 16]; [44]
<i>Perceived Managerial Support (PMS)</i>		
Top managers' Ability and Perception	Top managers' IT ability and perception refers to leaders' characteristics related to IT, which might differentiate between them with others in decision-making of technology adoption. Based on the related literature, we can consider top managers' IT knowledge under four aspects: perception of the IT trend of the operating environment, awareness of their enterprise in the domain of IT, knowledge of technologies itself, and general IT management knowledge.	[16; 45]; [43]
Top managers' Leadership Style	Leadership style is a leader's style of providing direction, implementing plans, and motivating people. Refers to the personal factors related to top managers that might make differences between them with others. It includes three facets: risk-taking leadership style, IT-oriented leadership style, and strategic-oriented leadership style.	[30; 46]
<i>Perceived Environmental Support (PES)</i>		
Government Leadership Infrastructure	Represents the issues reflect the role of government and its institutions, in orienting, improving, developing, regulating and managing, and monitoring e-commerce environment. It includes four facets: strategic directive role (visions and commitment), practical directive role (e-Government initiatives), national support role, and international support role.	[9]; [47]; [13]
Legal and Regulatory Infrastructure	Represents legal requirements and regulations to stop or eliminate risks in e-business transactions. It includes four facets related to: traditional risks, e-transactions risks, international e-commerce risks, and industry-specific e-commerce risks.	[48]
IT & other Supporting Industries Infrastructure	Represents technical factors required to overcome the technological challenges, such as interoperability, security, inadequate software, connectivity, and reliability. It includes three technological aspects: IT applications available and Internet infrastructure, B2B e-initiates available, and G2B e-initiates. Also represents necessary industrial infrastructure organized by the industry itself to support the business communication, collaboration, and management between enterprises as well as the enterprises with government institutions. It includes two information aspects: cross-industrial information and public administration information. Also refers to the presence, development, service level and cost structure of three major supporting industries: telecommunications, financial system, and transportation system whose activities might affect e-commerce initiatives in businesses in developing countries.	[47] [26]

Social-economic and knowledge Infrastructure within the industry	Represents issues related to social culture, knowledge, and attitudes of a community or the industry towards e-commerce. It has four facets: (1) industrial economic characteristics (competitiveness, transparency, stableness; trend of collaboration and cooperation), (2) industrial socio-culture characteristics (trust, beliefs, concepts, judgments, expectations, and methodologies towards e-commerce) that are shared by people and enterprises within the industry. (3) They are also industrial knowledge characteristics (perception of e-procurement, skilled labor force, technicians, IT-oriented managers) that required for the development of e-procurement strategy, and (4) industrial knowledge sharing supporting infrastructure (all initiatives, actions, and plans available that develop knowledge and positive culture for e-commerce).	[47]; [49]
Perceived Technological Supports (PTS)		
Positive attitude towards the institutionalization of e-procurement	Refers to top managers' belief that the institutionalization of e-procurement will be an important part within their enterprise's comprehensive business and management strategy; and the institutionalization finally enhance the enterprise's performance.	[15]
Positive subjective norm related to the Institutionalization	Refers to top managers' perception that most referents who are important to their enterprise (e.g. government, partners, competitors, and customers) think the enterprise should or should not institutionalize e-procurement in question.	[15]
E-procurement Institutionalization	An organization is considered to have institutionalized e-procurement if it has: <ul style="list-style-type: none"> - Deployed generally one or several of the e-procurement innovations for almost their purchases (more than 50%) and most of the procurement processes can be conducted electronically, and - Innovations deployed have a good interoperability together, with existing organizational systems, and with external e-infrastructure through transactive or integrated websites that connected to e-marketplaces, and - Innovations deployed are consistent with the business strategy, organizational structure, and social environment with the enterprise. 	[26]; [50]; [6]; [51]; [3]; [5]
E-procurement Initial Adoption	An organization is considered to have adopted initially e-procurement if it has been: <ul style="list-style-type: none"> - deployed only one or several of the e-procurement innovations for a small part of their purchases; - used the static or interactive websites to make promotions and publish basis company information or receive queries, e-mail, and form entry from users. 	[26; 50]; ; [52]; [6]; [51]

Appendix B - Initial measures for latent variables

Constructs	Measurement Items/survey questions	References
Internal Organizational Characteristics (IOC)	IOC1: Our top managers commit strongly on IT; especially, we have a specific IT steering committee for managing various aspects of business-IT fit IOC2: Our enterprise business model and strategy are suitable to accommodate e-commerce innovations IOC3: The organizational culture of our enterprise is IT-based oriented IOC4: Most information within our organization is processed electronically IOC 5: Our organizational structure is flexible enough for changes management.	[19]; [1]; [50]
External Business Characteristics (EBC)	EBC 1: Our enterprise is operating in a dynamic environment with a trend of strong cooperation and collaboration; EBC 2: The target market of our enterprise is wide both domestic and international, which are incentive and	[16]; [53]; [1]

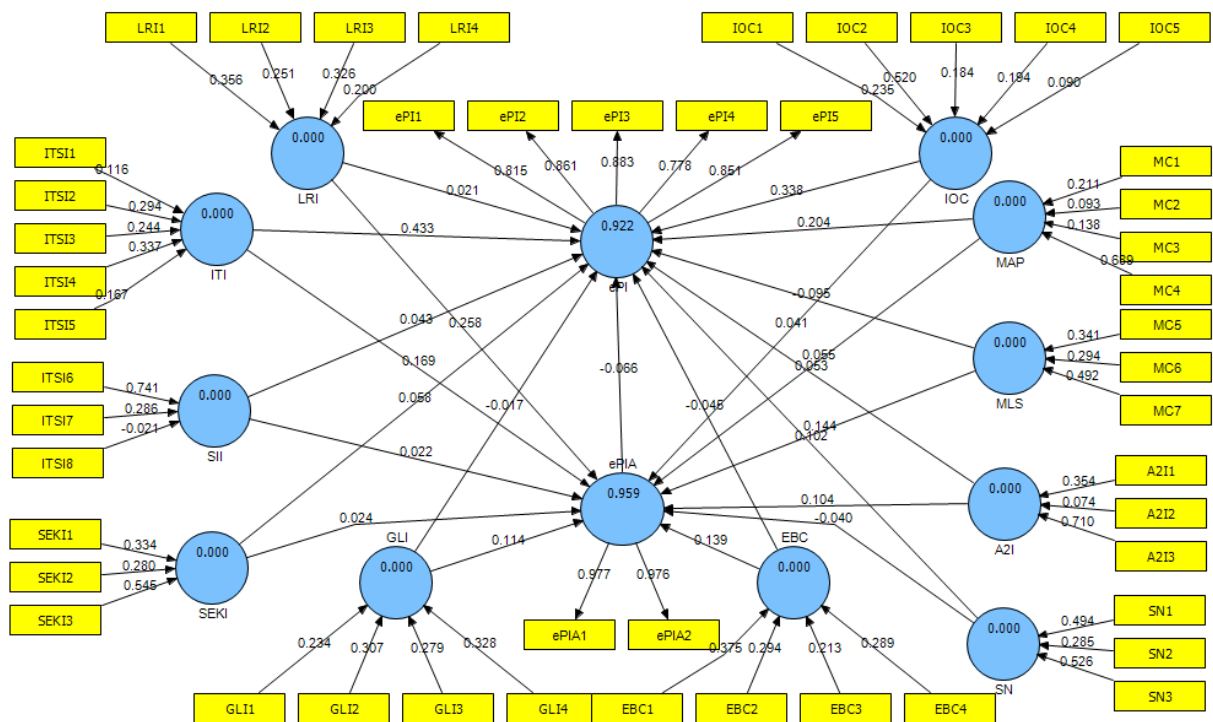
	<p>supportive strongly to apply e-procurement tools;</p> <p>EBC3: Our enterprise's main competitors, partners, and customers are using sophisticatedly e-procurement innovations;</p> <p>EBC4: Our enterprise's business activities are strongly integrated within supply chain.</p>	
Top managers' characteristics (MC)	<p>MC1: Our managers are good aware of all aspects of e-procurement in terms of benefits, challenges, and role;</p> <p>MC2: Our managers are good aware of business in terms of internal resources and external business characteristics;</p> <p>MC3: Our managers are good aware of operating environment in terms of the business trends, barriers and supports in the domain of e-procurement in the industry;</p> <p>MC4: Our managers have IT & changes management ability; MC 5: Our managers have a strategic-oriented leadership style;</p> <p>MC 6: I believe that managers have an IT-oriented leadership style;</p> <p>MC 7: I believe that managers have a risk-taking leadership style.</p>	[16]; [4]; [1]; [43]
Government Leadership Infrastructure (GLI)	<p>GLI1: We believe that Government has a strong strategic commitment to general e-commerce across the nation with a comprehensive vision, effective actions plans, and incentive policies.</p> <p>GLI2: We believe that Government is effectively playing its pioneering role in facilitating the market demand for e-commerce through e-Government initiatives (e.g. public e-procurement, public websites); reengineering in state organizations is being undertaken; officials are well trained and have positive attitudes towards public e-services.</p> <p>GLI3: We believe that Government has been making many efforts to the development of e-commerce towards the regional and international scope; many bilateral and multi-parties agreements with international governments and organizations that related to legal issues, standards, security, etc. have been signing.</p> <p>GLI4: We believe that Government has paid especially attention on the development of e-commerce in SMEs.</p>	[10]; [47]
Legal and Regulatory Infrastructure (LRI)	<p>LRI 1: We believe that the present paper-based procurement legal system is well-defined to address traditional legal risks (e.g. corruption, bureaucracy, fraudulent, jurisdiction, intellectual properties rights, etc.)</p> <p>LRI 2: We believe that the present e-procurement legal system is well-defined to address e-transactions risks (e.g. software agents contracting, authentication, online security, privacy, etc.)</p> <p>LRI 3: We believe that the present e-commerce legal and regulatory system is unified with international legal defines;</p> <p>LRI 4: We believe that the present e-commerce legal and regulatory system takes sufficiently into account the needs of both public vs. private enterprises and large vs. SMEs as well in the industry.</p>	[54], [48]
IT and Supporting Industries Infrastructure (ITSI)	<p>ITSI1: We believe that supporting IT applications and Internet is available and good enough to support well e-procurement activities with regards to interoperability, reliability, security, and standardization in the industry.</p> <p>ITSI2: We believe that B2B e-initiatives have been developed well in the industry (websites, e-marketplaces, e-hubs, etc.).</p> <p>ITSI3: We believe that e-Government initiatives have been developed well (e.g. public e-communication, e-bank system, public e-certificate service, e-tax declaration and clearance, and public e-procurement);</p> <p>ITSI4: We believe that across-industrial information sources are available, transparency, and accessible equally;</p>	[26]; [12]; [53]

	<p>ITSI5: We believe that public administration institutions have established e-databases of economic and administration information; they are available and fair for enterprises.</p> <p>ITSI6: We believe that national financial system are improved and institutionalized enough to handle e-commerce;</p> <p>ITSI7: We believe that telecommunications system is improved and institutionalized well to support e-commerce;</p> <p>ITSI8: We believe that transportation system is improved and institutionalized well to support e-commerce.</p> <p>SEKI1: We believe that socio-cultural environment is now very incentive and supportive for e-procurement because of improved trust on e-transactions; improved e-payment activities; enhanced active style of working & managing within the industry.</p> <p>SEKI2: We believe that enterprise community in the industry is well aware of short-time vs. long-term benefits; has positive attitudes towards e-commerce; has enough skilled labor force, technicians, and managers that required for the development of e-commerce strategy</p> <p>SEKI3: We believe that economic environment is very good in terms of competitiveness, transparency, stableness; and has a strong trend of collaboration and cooperation.</p> <p>SEKI4: We believe that the economic environment is IT-oriented strongly</p>	[1]; [47]; [49]
Socio-economic and knowledge Infrastructure within the industry (SEKI)		
Attitude towards institutionalizing e-procurement (A2I)	<p>A2I1: We believe that the institutionalization will bring fully cost advantages of e-procurement to our enterprise.</p> <p>A2I2: We believe that the institutionalization will make strategic long-term benefits for our enterprise.</p> <p>A2I3: We believe that the institutionalization will make strong competitive advantage to our enterprise.</p>	[15]
Subjective Norm related to the Institutionalization (SN)	<p>SN1: We think that our business main partners seem to want our enterprise to institutionalize e-procurement.</p> <p>SN2: We think that our main competitors seem to want our enterprise towards the institutionalization of e-procurement.</p> <p>SN3: We think that Government seems to want our enterprise to institutionalize e-procurement.</p>	[15]
E-procurement initial adoption (ePIA)	<p>ePIA1: Our enterprise has been implementing one or several e-procurement innovations separately for a small part of the total purchases.</p> <p>ePIA2: Our enterprise has been using the static or interactive websites to make promotions and publish basis company information or receive queries, e-mail, and form entry from users.</p>	[26], Self-developed
E-procurement Institutionalization Propensity(ePI)	<p>Our enterprise has implemented or planned to, in near future.;</p> <p>ePI1: Implement major amount of our purchases through e-procurement innovations;</p> <p>ePI2: Implement most procurement processes (from informing to payment) in electronic format;</p> <p>ePI3: Improve higher interoperability between e-procurement innovations together and with other IT systems;</p> <p>ePI4: Improve higher interoperability between e-procurement innovations with external IT infrastructure through transactive or integrated websites, and participating e-marketplace;</p> <p>ePI5: Implement e-procurement innovations more consistent with our business strategy, organizational structure, and social environment within our enterprise.</p>	[26], Self-developed

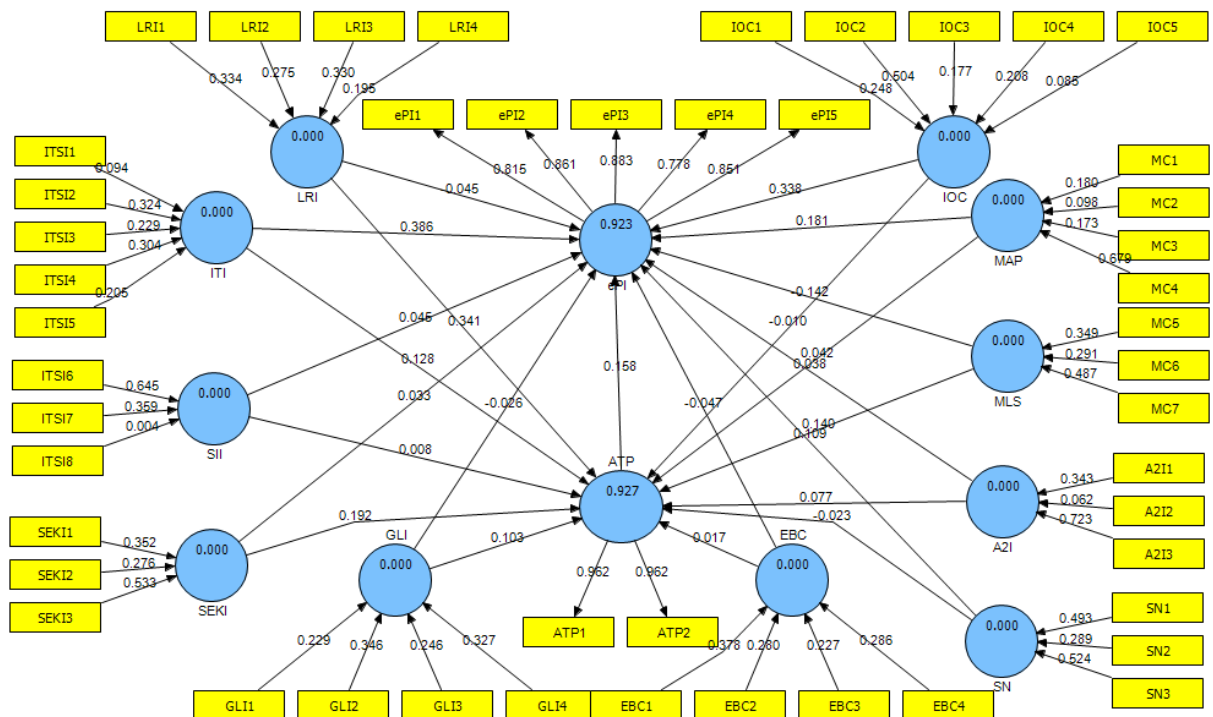
Appendix C - VIF, weights, loadings, and t – values of the indicators (within an initial model)

	VIF	Weights	T Statistics(of Weights)	Loadings	T Statistics (of Loadings)
GLI1 -> GLI	2.29	0.23	3.79	0.84	25.82
GLI 2 -> GLI	2.37	0.31	4.90	0.87	27.44
GLI 3 -> GLI	2.47	0.28	4.62	0.87	26.71
GLI 4 -> GLI	2.71	0.33	5.64	0.90	34.82
SEKI1 -> SEKI	1.14	0.34	5.23	0.75	12.13
SEKI 2 -> SEKI	1.32	0.25	2.52	0.63	6.03
SEKI 3 -> SEKI	1.45	0.52	4.63	0.84	13.72
SEKI4 -> SEKI	1.19	0.11	1.10	0.41	4.66
ITSI1 -> ITSI	2.12	0.10	2.32	0.74	12.07
ITSI 2 -> ITSI	3.58	0.30	6.09	0.90	48.00
ITSI 3 -> ITSI	3.11	0.23	3.78	0.86	29.98
ITSI 4 -> ITSI	2.88	0.32	6.04	0.88	20.60
ITSI 5 -> ITSI	2.62	0.15	2.40	0.79	17.41
ITSI 6 -> ITSI	3.21	0.14	5.36	0.89	38.83
ITSI7 -> ITSI	2.36	0.10	0.97	0.76	18.42
ITSI8 -> ITSI	1.21	0.04	0.16	0.29	2.80
LRI1 -> LRI	2.94	0.36	6.56	0.91	43.94
LRI 2 -> LRI	2.49	0.25	3.84	0.88	38.16
LRI 3 -> LRI	2.36	0.33	5.16	0.88	27.77
LRI 4 -> LRI	2.86	0.20	3.27	0.85	25.05
MC1 -> MC	1.65	0.18	3.39	0.70	9.82
MC2 -> MC	2.07	0.03	0.62	0.69	13.03
MC3 -> MC	3.07	0.02	0.37	0.80	17.52
MC 4 -> MC	5.04	0.36	4.34	0.95	68.10
MC 5 -> MC	3.35	0.16	2.61	0.85	29.18
MC 6 -> MC	2.76	0.17	3.33	0.83	20.96
MC 7 -> MC	3.06	0.27	4.51	0.89	37.07
IOC1 -> IOC	1.68	0.24	5.27	0.75	15.07
IOC2 -> IOC	2.63	0.52	7.12	0.94	44.47
IOC3 -> IOC	1.34	0.19	3.47	0.63	10.14
IOC4 -> IOC	2.17	0.19	3.08	0.81	18.84
IOC5 -> IOC	1.82	0.09	1.99	0.70	13.18
EBC1 -> EBC	2.44	0.38	5.56	0.89	39.92
EBC2 -> EBC	2.02	0.29	5.03	0.84	26.45
EBC3 -> EBC	2.31	0.21	3.31	0.83	23.08
EBC4 -> EBC	2.08	0.29	5.01	0.84	18.96
SN1 -> SN	1.76	0.50	4.22	0.83	19.92
SN2 -> SN	1.71	0.29	3.63	0.79	15.93
SN3 -> SN	1.91	0.53	5.96	0.92	29.67
A2I1 -> A2I	1.96	0.35	4.25	0.63	18.91
A2I 2 -> A2I	1.89	0.07	3.63	0.79	17.92
A2I 3 -> A2I	1.93	0.71	5.76	0.82	27.67

Appendix D – The modified theoretical model



Appendix E - Illustrate example results for a Changed Nomological Network (PLS)



Appendix F – Final measuring items for independent and dependent variables

Constructs	Measurement Items/survey questions
Internal Organizational Characteristics (IOC)	<p>IOC1: Our top managers commit strongly on e-procurement; especially, we have a specific IT steering committee for managing various aspects of business-IT fit;</p> <p>IOC2: Our enterprise business model and strategy are suitable to accommodate e-procurement innovations;</p> <p>IOC3: The organizational culture of our enterprise is IT-based oriented, and supportive to e-procurement innovations;</p> <p>IOC4: Most information within our organization is processed electronically;</p> <p>IOC 5: Our organizational structure is flexible enough for changes management.</p>
External Business Characteristics (EBC)	<p>EBC 1: Our enterprise is operating in a dynamic environment with a trend of strong cooperation and collaboration;</p> <p>EBC 2: The target market of our enterprise is wide both domestic and international, which are incentive and supportive strongly to apply e-procurement tools;</p> <p>EBC3: Our enterprise's main competitors, partners, and customers are using sophisticatedly e-procurement innovations;</p> <p>EBC4: Our enterprise's business activities are strongly integrated within supply chain.</p>
Managers' ability and perception (MAP)	<p>MAP1: Our managers are good aware of all aspects of e-procurement in terms of benefits, challenges, and role;</p> <p>MAP2: Our managers are good aware of operating environment in terms of the business trends, barriers and supports in the domain of e-procurement in the industry;</p> <p>MAP3: Our managers are good aware of business in terms of internal resources and external business characteristics;</p> <p>MAP 4: Our managers have IT & changes management ability.</p>
Managers' leadership style (MLS)	<p>MLS1: Our managers have a strategic-oriented leadership style;</p> <p>MLS2: I believe that managers have an IT-oriented leadership style;</p> <p>MLS3: I believe that managers have a risk-taking leadership style.</p>
Government Leadership Infrastructure (GLI)	<p>GLI1: I believe that Government has a strong strategic commitment to general e-commerce across the nation with a comprehensive vision, effective actions plans, and incentive policies.</p> <p>GLI2: I believe that Government is effectively playing its pioneering role in facilitating the market demand for e-commerce through e-Government initiatives (e.g. public e-procurement, public websites); reengineering in state organizations is being undertaken; officials are well trained and have positive attitudes towards public e-services.</p> <p>GLI3: I believe that Government has been making many efforts to the development of e-commerce towards the regional and international scope; many bilateral and multi-parties agreements with international governments and organizations that related to legal issues, standards, security, etc. have been signing.</p> <p>GLI4: I believe that Government has paid especially attention on the development of e-commerce in the construction industry and SMEs.</p>
Legal and Regulatory Infrastructure (LRI)	<p>LRI 1: I believe that our paper-based procurement legal system is well-defined to address traditional legal risks (e.g. corruption, bureaucracy, fraudulent, jurisdiction, intellectual properties rights, etc.)</p> <p>LRI 2: I believe that our e-procurement legal system is well-defined to address e-transactions risks (e.g. software agents contracting, authentication, online security, privacy, etc.)</p> <p>LRI 3: I believe that our e-commerce legal and regulatory system is unified with international legal defines;</p> <p>LRI 4: I believe that our e-commerce legal and regulatory system takes sufficiently into account the needs of both public vs. private enterprises and large vs. SMEs as well in the industry.</p>

Information Technology Infrastructure (ITI)	<p>ITI1: I believe that supporting IT applications and Internet is available and good enough to support well e-procurement activities with regards to interoperability, reliability, security, and standardization in the industry.</p> <p>ITI2: I believe that B2B e-initiatives have been developed well in the industry (websites, e-marketplaces, e-hubs, etc.).</p> <p>ITI3: I believe that e-Government initiatives have been developed well (e.g. public e-communication, e-bank system, public e-certificate service, e-tax declaration and clearance, and public e-procurement).</p> <p>ITI4: I believe that across-industrial information sources are available, transparency, and accessible equally;</p> <p>ITI5: I believe that public administration institutions have established e-databases of economic and administration information; they are available and fair for enterprises.</p>
Supporting Industries Infrastructure (SII)	<p>SII1: I believe that national financial system are improved and institutionalized enough to handle e-commerce;</p> <p>SII2: I believe that transportation system is improved and institutionalized well to support e-commerce;</p> <p>SII3: I believe that telecommunications system is improved and institutionalized well to support e-commerce.</p>
Socio-economic and knowledge Infrastructure within the industry (SEKI)	<p>SEKI1: I believe that socio-cultural environment is now very incentive and supportive for e-procurement because of improved trust on e-transactions; improved e-payment activities; enhanced active and independent style of working and managing within the industry;</p> <p>SEKI2: I believe that enterprise community in the industry is well aware of short-time vs. long-term benefits; has positive attitudes towards e-procurement; has enough skilled labor force, technicians, and managers that required for the development of e-procurement strategy;</p> <p>SEKI3: I believe that economic environment is very good in terms of competitiveness, transparency, stableness; and has a strong trend of collaboration and cooperation.</p>
Positive Attitude towards the institutionalization of e-procurement (A2I)	<p>Generally, I think that our enterprise have positive attitudes towards, a high willingness in, implementing e-procurement more sophisticatedly, because:</p> <p>A2I1: The institutionalization will bring fully cost advantages of e-procurement to our enterprise;</p> <p>A2I2: The institutionalization will make strategic long-term benefits for our enterprise;</p> <p>A2I3: The institutionalization will make competitive advantage to our enterprise.</p>
Positive Subjective Norm related to the Institutionalization (SN)	<p>Generally, our enterprise should institutionalize e-procurement because:</p> <p>SN1: Business main partners seem to want our enterprise to institutionalize e-procurement;</p> <p>SN2: Main competitors seem to make much business competitive pressures on our enterprise towards the institutionalization of e-procurement;</p> <p>SN3: Government seems to want our enterprise to institutionalize e-procurement.</p>
E-procurement initial adoption (ePIA)	<p>ePIA1: Our enterprise has been implementing one or several e-procurement innovations separately for a small part of the total purchases.</p> <p>ePIA2: Our enterprise has been using the static or interactive websites to make promotions and publish basis company information or receive queries, e-mail, and form entry from users.</p>
E-procurement Institutionalization Propensity (ePI)	<p>In our enterprise:</p> <p>ePI1: One or several e-procurement innovations are implemented in almost our purchases;</p> <p>ePI2: Most procurement processes have been conducting electronically;</p> <p>ePI3: E-procurement innovations implemented have a good interoperability together, and with other IT systems;</p> <p>ePI4: E-procurement innovations implemented have a good interoperability with</p>

	external IT infrastructure through transactive or integrated websites, and e-marketplace;
	ePI5: E-procurement innovations implemented are consistent with our business strategy, organizational structure, and social environment within our enterprise.
An enterprise's attitude towards e-procurement itself (ATP)	ATP1: I think that our enterprise considers e-procurement is as a long-term strategic rather than a short-term operational decision. ATP2: I think that our enterprise considers e-procurement is one of the most important strategies for the development of our enterprise.

Note:

- Manifest variables measured on a five-point Likert scale ranging from "Strongly Disagree" (value =1) to "Strongly Agree" (value =5).
- E-procurement Innovations include e-Informing, e-Catalog, e-Tendering, e-Bidding, e-Reverse Auctioning, e-Awarding, e-Contracting, e-Invoicing, and e-Payment.

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