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Assessment of Internet-based e-Commerce Readiness in Vietnamese Construction Enterprises: Towards an Industry-Oriented Framework and a Context-Specific Instrument

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Abstract: There has been a need to develop an industry-oriented e-commerce readiness assessment tool for the construction sector, especially in developing countries' context. This present study proposed such a framework that properly consider both the organizational and environmental e-readiness and pay more appropriately attention on information issue. A set of context-specific measurement items that is specific to the Vietnamese construction industry was developed. The proposed tool can assist well construction firms in developing countries in creating their own effective action plan towards the initial adoption of Internet-based B2B e-commerce into their business.

Key words: E-commerce, e-readiness, assessment tool, construction industry, Vietnam

INTRODUCTION

The Construction Industry (CI) is characterized mainly by the fragmentation and the one-off nature of the product (Stewart *et al*., 2003). Each construction project has its supply chains that include architects, engineers, project managers, contractors, quantity surveyors, subcontractors, material suppliers and self-employed professionals or artisans. This makes many information technology projects in CI were unsuccessful with regard to their business objectives and expected benefits (Lou, 2010). Too, the uptake of e-business in construction industry has been relatively limited and ineffective as in comparison to other industries in both developed and developing countries (Anumba and Ruikar, 2002). However, the literature consistently demonstrates business transactions and collaboration among these supply-chain members are increasingly based on electronic format (Nitithamyong and Skibniewski, 2004). The fact also shows implementing Internet-based technologies helps to achieve business and management targets, bring about significant changes within construction organizations in processes and culture (Anumba and Ruikar, 2002). Therefore, it can be said that the use of Internet-based e-commerce tools is unavoidable in the industry.

In Vietnam, there have been a lot of efforts made to develop a more incentive environment for e-commerce (VECITA, 2009). However, most construction enterprises are, so far, still at the early stage of adoption of simple e-commerce technologies for short-term targets (VECITA, 2009). The diffusion and the rate of the successful implementation of these technologies in the sector are actually very low and do not match with the level of infrastructure development (Tran *et al*., 2011a; VECITA, 2009). Especially, the doubt psychology on the success of the implementation of Internet-based e-commerce technologies exists strongly in the industry (Tran *et al*., 2011b). As we know, the successful implementation of e-commerce in an enterprise requires a large number of changes within the enterprise's internal and external environments. Therefore, it is important to understand how businesses in developing countries could make an effective adoption plan to gain benefits from the technology. Hence, the purposes of this study are to:

- Suggest a theoretically construction-oriented e-readiness model of Internet-based Business-to-Business (B2B) e-commerce adoption to identify the relevant internal and external environmental factors that affect the successful implementation of the technology in developing countries
- And develop the pools of contextual-specific measures that fully capture the essence of each construct in the proposed framework and the unique characteristics of the Vietnamese construction industry

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The present study is only a qualitative research. There is a need to test empirically this study's proposed framework and measures in further research. Once, the instrument is empirically validated it can help construction enterprises to identify their weaknesses and strengths and to create their own effective action plan towards the entry-level adoption of Web-based B2B e-commerce.

E-COMMERCE IN VIETNAMESE CONSTRUCTION INDUSTRY (VCI)

In Vietnam-a developing country, both Government and enterprises have strongly recognized the strategic role of e-commerce in the development of the economy. The government's role in fostering the diffusion of e-commerce is increasingly important through reforming programs and IT initiatives (VECITA, 2009). Generally, the infrastructure for e-commerce in Vietnam has become more favorable and incentive with regards to legal and policy issues, public e-services, security, standard, e-payment and international e-trading agreements (VECITA, 2009). Business community is also increasingly using e-commerce at different levels in terms of sophistication, effectiveness and efficiency.

For the construction sector, the fact shows that most enterprises are still at the first stage of adoption of simple e-commerce technologies for short-time targets (Tran *et al*., 2011a). It can be said that the diffusion level of the technologies are low and do not match with the infrastructure development. Main challenges to the adoption of e-commerce in the industry are in relation to cultural issue, change management ability, lacking of well-defined e-business models and ICTs infrastructure (Ca, 2003; Nguyen *et al*., 2007; VECITA, 2009; Ling *et al*., 2009; Nguyen *et al*., 2009). In addition, public officials' "frigidity" to e-commerce is also considered as a serious limitation (Long *et al*., 2004; Le-Hoai *et al*., 2010). The doubt psychology on the success of e-commerce technologies seems to wrap the industry, especially small and medium enterprises (Tran *et al*., 2011b). The unique characteristics of VCI were presented in more detail in Appendix 1.

THEORETICAL BACKGROUND

Recently, the literature of e-commerce acceptance has acknowledged that e-readiness perspective is a good foundation to study on the adoption and diffusion of the technology. E-readiness is considered as one of dominant factors to the success of the e-commerce implementation by individual enterprises (Neef, 2001; Molla, 2004; Aibinu and Al-Lawati, 2010; Lou, 2010). Therefore, assessing the state of e-readiness has become very important to enterprises that seek to adopt and implement e-commerce technologies. This provides an enterprise the basic upon which to build a planning process which in itself is an integral step in making sound policy and investment decisions (CID, 2006). Generally, definition of e-readiness is varied in different contexts, different users and for different purposes. Lou (2010) defined e-readiness as "a measure to which an organization or business may be ready, prepared or willing to adopt, use and benefits arise from the digital economy such as e-procurement." While Ruikar *et al*. (2006) defined e-readiness as "the ability of an organization, department or workgroup to successfully adopt, use and benefit from information and communication technologies, such as e-commerce". Therefore, to make the aim of the study tractable, it was instructive to have an e-readiness definition for this present study. Here, we define that e-readiness for entry-level adoption (or initial adoption) of Internet-based B2B e-commerce as "a measure of the extent of a construction enterprise's internal resources and external resources to which the enterprise should make an adoption decision and the enterprise will more likely use and gain basic benefits from the technology."

There have been many efforts to develop the models and the measurement instruments which assist e-readiness assessment for the adoption/implementation of e-commerce at the firm level. However, the most of them have not paid enough attention on the impact role of contextual characteristics, industrial specific issues and the demands for planned applications (Janom and Zakaria, 2008). Related literature of e-commerce consistently demonstrates the important role of external factors on the adoption decisions and the success of the implementation of the technologies (Neef, 2001; Molla and Licker, 2005a). In addition, studies on e-commerce sophistication also considered the high integration level among the technology, the organization and the interorganizational environment as a critical condition for success of e-commerce (Raymond and St-Pierre, 2005; Rai *et al*., 2006; Raymond *et al*., 2012). It can be said that the environmental factors identified are generally associated to government commitments, legal issues, ICTs infrastructure, supporting industries and business channels (Neef, 2001; Stewart *et al*., 2003; Molla and Licker, 2005a; Ismail and Kamat, 2008a).

As we know, the nature of the construction industry is project-based; construction trading relationships are, traditionally, temporary; and construction collaboration are very fragmentary, especially in developing countries (Wilkinson, 2008; Ruikar *et al*., 2008). Moreover, the construction supply chains include many different actors, such as clients, architects, engineers, project managers, contractors, supplier, etc. Therefore, within the industry, e-commerce practices are commonly diffused through various operational clusters because of their business linkages and interdependence (London and Bavinton, 2006). Consequently, the adoption decision as well as the

success of the implementation of e-commerce in individual enterprises will depend much on the e-commerce state of their partners.

In addition, the construction industry is very knowledge-intensive. However, it has a high level of fragmentation and an innate conservatism as well as lacks channels that support sharing and transferring information and knowledge of innovation. This makes key knowledge assets are often looked-up in each enterprise or even in each department of firm (Egbu, 2008). Therefore, for construction-oriented studies on the Web-based B2B e-commerce adoption they need to place the adoption process into a wider socio-economic communication system (London and Bavinton, 2006). Besides aspects mentioned above, industrial cultural issues and IT knowledge infrastructure should be also paid especially attention with such the studies.

According to Mutula and van Brakel (2006), the importance of information to individuals and organizations is growing rapidly when it drives our communication, decision-making and reactions to the entire environment. The way information was structured, stored, retrieved and manipulated through the formalism of information modeling was of critical importance in e-readiness assessments (Mutula and van Brakel, 2006). Given skilled human resource, appropriate technology infrastructure, good management and integrated process; however, if it lacks information resource the system would not operate in an efficient manner. Thus, information infrastructure issues at both the industrial and organizational levels should be considered appropriately when assessing enterprises' e-readiness to adopt e-commerce.

Based on the above discussion, a more comprehensive e-readiness assessment framework which can effectively assist individual enterprises in developing countries in making their own effective action plan towards the successful implementation of the e-commerce, will be developed.

RESEARCH METHODOLOGY

Literature shows that the triangulation methodology that involves the use of both qualitative and quantitative approaches is more effective in building an e-readiness model. Accordingly, the e-readiness framework and the set of measurements will be developed qualitatively and then should be tested quantitatively. In this study, we only present the qualitative part of the study to develop the e-readiness assessment model. Further research will be needed to test empirically the framework and the instrument proposed.

Consequently, the authors firstly conduct an analysis of the nature of the construction industry as well as of the e-commerce adoption process. Next, a discussion of strengths and weaknesses of the existing e-readiness models was carried out. Based on the results gained, the authors proposed a construction-oriented e-readiness assessment framework aimed at the initial adoption of e-commerce in individual enterprises in developing countries.

In order to build the pools of contextual-specific measurement items for each constructs of the proposed framework, a three-step approach was applied. Firstly, based on the unique characteristics of Vietnamese Construction Industry (VCI), a preliminary set of items that reflect the contextual features was identified. Next, supplementary items that drawn from the existing e-readiness models and tools were identified and were added. Lastly, a refining process was carried out to gain a final set of items. This procedure will help to ensure the identifying of contextual-specific items would not suffer by the adopting of related items developed in previous models but also to ensure the items fully capture the essence of the constructs.

A REVIEW OF E-READINESS ASSESSMENT MODELS AND TOOLS

It should be noted again that this study is to develop an industry-oriented e-readiness assessment model at the organizational level. It does not attempt to carry out a comprehensive review of the assessment of models or tools. Instead, the review focuses only on existing models which are considered to be important and of value to the present study.

For the national/industrial level, there is a wide range of e-readiness assessment models available. For example, the APEC's guideline proposes six dimensions of e-readiness, including ICTs infrastructure, law and security, e-business climate, Internet infrastructure, government leadership and human development. The 1999 KAM acknowledged four areas, including long-term investments in education, developing innovation capability, modernizing the information infrastructure and a conductive economic environment. The MDBs' guideline of e-Government procurement also focuses on leadership, e-commerce vision, legal frameworks; ICTs infrastructure; people and resources; current procurement processes management, adoption of e-procurement systems (MDBs, 2004). In summary, e-readiness for e-commerce at the national level has been considered around five major segments, namely: Leadership/visions, legal and regulatory infrastructure, human resource, ICTs infrastructure and a conductive economic environment. There has been a common limitation of these models is that they did not pay appropriately attention on the role of information issue which is considered as a key factor of Internet-based IT development (Mutula and van Brakel, 2006).

At the firm level, there have been many e-readiness assessment models and tools, such as SCALES, RACE, IQ Net Readiness Scorecard, VERDICT and so on. However, VERDICT is a unique model developed to assess e-readiness of construction organizations towards adoption of e-commerce. As most existing e-readiness models it failed to consider the role of external factors on e-commerce adoption decision (Janom and Zakaria, 2008). The following are two models that of particular relevance to our present study:

- VERDICT is developed by Ruikar *et al.* (2006) to assess e-readiness of an individual construction organization to adopt e-commerce technologies. The triangulation methodology is adopted for the development of the model. VERDICT posited only management, processes, people and technology are the four key aspects that affect the successful adoption of e-commerce. The strong point of the model is flexible and applicable when it can help to identify areas or aspects that need to be improved before an e-commerce adoption decision made (Ruikar *et al.*, 2006). However, the authors found out serious drawbacks of the model as the following:
  - The assessing e-readiness focuses only on internal factors of an organization but does not consider impacts from external environment (Janom and Zakaria, 2008)
  - It fails to address properly the information issue (Mutula and van Brakel, 2006)
  - In VERDICT, industry-specific considerations were not considered appropriately (Janom and Zakaria, 2008)
  - Finally, VERDICT is only intended towards a developed country's construction context (UK)

- The Molla and Licker (2005b) developed the PERM model under the notion of perceived e-readiness of e-commerce awareness; managerial commitment and internal organizational resources and external contextual supports for e-commerce. The model provides good predictors of e-commerce adoption as well as is flexible enough to capture characteristics of developing countries' context. Main advantages of the model, namely:
  - Identifying factors that influence on adoption and subsequent development of e-commerce was based on a multi-perspective audit of management, internal resources and external issues

The role of external environment was paid attention through top managers' perception:

- The model's instrument helps to identify firms' business practices that could barrier e-commerce adoption. Thus, it can effectively assist managers in creating a more comprehensive action plan towards e-commerce.

Finally, the study was one of very few of studies that focused on the nature of adoption process by differentiating initial adoption vs. institutionalization of e-commerce.

However, this model failed to consider the importance of information issue (Mutula and van Brakel, 2006) and inherent attributes of the targeted technology (Janom and Zakaria, 2008). It also failed to assess the role of social-economic and IT knowledge infrastructure in the specific industry in where e-commerce adopted.

Based on the results discussed in previous sections, next the authors present a construction-oriented e-readiness model proposed.

A CONSTRUCTION-ORIENTED E-COMMERCE READINESS FRAMEWORK AND DESCRIPTIONS OF CONSTRUCTS

A construction-oriented e-readiness assessment framework consists of two main components, namely a construction enterprise's Available Resource (AR) and key managers' Perception of External environment (PE). The AR component has five categories: Managerial resource, business resource, human resource, technological resource and information resource. The PE component has 6 constructs, including Leadership and Management Infrastructure, Legal and Regulatory Infrastructure, Technological Infrastructure, Information Infrastructure, Supporting Industries Infrastructure and Socio-economic and Knowledge Infrastructure (within the industry). The framework will assist construction enterprises in developing countries to create their own action plan towards the early adoption of Internet-based B2B e-commerce (Fig. 1).

The proposed: The assessment of e-readiness relies on the judgment of the respondent (a key manager of an organization) as whether or not he/she agrees with the statement/s in the context of their organization. The extent to which the respondent agrees or disagrees with the statement is graded on a Likert-type scale of 1-5, where (1) Strongly disagree, (2) Disagree, (3) Neutral, (4) Agree and (5) Strongly agree. The statements are designed that a response of strongly agree will generate the highest score of 5 points. An average score is calculated for each category. Taken together, these eleven constructs are hypothesized to predict an adoption decision of Web-based e-commerce and explain a significant part of

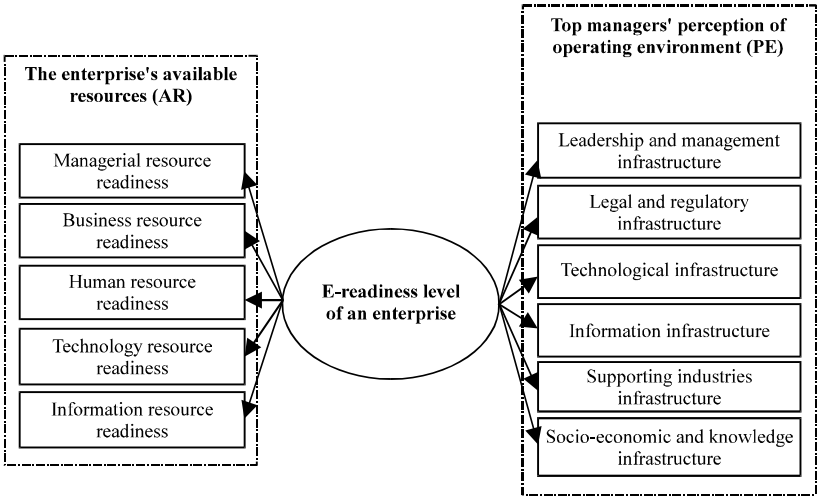

Fig. 1: The proposed industry-oriented framework for assessment of internet-based e-commerce readiness of construction enterprises in developing

the variance in the success level of the implementation of e-commerce technologies by individual construction enterprises. If a certain construction enterprise has simultaneously all eleven "e-ready" categories, it seems to have the high potential in adopting and implementing successfully Internet-based e-commerce technologies.

The following is descriptions of the constructs of the proposed framework.

Managerial Resource of a construction enterprise (MR) is important factors in terms of vision, strategies, top commitments and policies that leads and governs the adoption, implementation and use of the technology within organizations. They support for e-commerce from all corners of an organization and especially from the strategic apex, such as a clear-cut e-commerce vision, effective e-commerce leadership and organizational commitments of e-commerce ideas and projects (Molla and Licker, 2005a).

Business Resource of a construction enterprise (BR) that covers a wide range of capabilities of the intangible assets of the organization (Molla and Licker, 2005b). It includes the working rules, ethics and procedures within organizations, the openness of organizational communication, risk-taking behavior, existing business relationships, finance and a series of actions done towards e-commerce (Ruikar *et al*., 2006; Molla and Licker, 2005b). Good business resource will ensure the integration between the technology applied and business processes as well as the integration in e-transactions between organizations (Ruikar *et al*., 2006).

Human Resource of a construction enterprise (HR) is related to those who have specialist skills, understanding of and belief in, the technology. It accounts for the knowledge, social and cultural aspects related to managers, staffs or employees within an organization or a certain project. Given management and business resources are incentive and ready to adoption of e-commerce, it is less likely to succeed to its full potential, if the people are not ready in terms of skill, knowledge, experience, trust and commitment that related to e-commerce (Tan *et al*., 2007; Ruikar and Anumba, 2008; Molla and Licker, 2005b).

Technology Resource of a construction enterprise (TR) is necessary demands to support the business functions in the domain of technology. It includes the hardware, software, its availability and flexibility and its performance within a company. Here, technology's performance need to be paid much more attention in the construction industry where data is more complex in terms of content and sharing network, larger in size (Tan *et al*., 2007; Molla and Licker, 2005b).

Information Resource of a construction enterprise (IR) is necessary internal information organized to support the business communication, collaboration and management within the enterprise and with other enterprises within its supply chains. It includes database, quality, liquidity and accessibility of information. Given a good technology infrastructure is in place, it is less likely to gain a new technology's full benefits if information resource is not ready in terms of content and accessibility (Mutula and van Brakel, 2006).

Leadership and Management Infrastructure (LMI) within the industrial environment is issues that reflect the role of government and its related institutions in orienting, improving, developing, regulating and managing and monitoring e-commerce environment. It includes visions and commitments, plans, strategies, policies, supports and other issues related to socio-cultural knowledge development and Internet security (Ruikar *et al*., 2006; Ismail and Kamat, 2008b).

Legal and Regulatory Infrastructure (LRI) within the national/industrial environment is legal requirements and regulations that stop or eliminate risks in e-business transactions. The legal issues associated with integrated network can be categorized into global issues, intellectual property rights, e-contact, enforceability issues, liability risks and security breaches. They can include agency, jurisdiction, contract formation, validity and errors, authentication, attribution and non-repudiation and privacy concerns (Ismail and Kamat, 2006; Kog, 2010; APEC, 2006). The literature of legislation in construction e-commerce consistently demonstrates a need of an effective legal and regulatory system for trust, performance of construction e-contracts and e-commerce revenues (Nitithamyong and Skibniewski, 2004; Ismail and Kamat, 2006; Kog, 2010).

Technology Infrastructure (TI) within the national/industrial environment is a set of factors required to overcome the technological challenges, such as interoperability, security, inadequate software, connectivity and reliability. It include hardware, software, networking protocols (e.g., Internet), networking security technology and e-payment technology, technological standards, etc. and their availability and performance in the industry (Ruikar *et al*., 2006; Ismail and Kamat, 2008a).

Information Infrastructure (II) within the national/industrial environment is necessary external information organized by the industry itself to support the business communication, collaboration and management between enterprises as well as the enterprises with government institutions. It also includes all aspects of information, such as database, quality, liquidity and accessibility but at the industrial level. A dynamic information sharing and exchanging environment is crucial for e-commerce activities (Mutula and van Brakel, 2006; Ismail and Kamat, 2008b).

Supporting Industries Infrastructure (SII) is refers to the presence, development, service level and cost structure of support-giving institutions such as telecommunications, financial, transportation and trust enablers, whose activities might affect the e-commerce initiatives of businesses in developing countries (Molla and Licker, 2005a).

Social-economic and Knowledge Infrastructure within the national/industrial environment (SEKI) is issues related to social culture, knowledge and attitudes of a community or the industry towards e-commerce. It can include the knowledge, attitudes, truths, beliefs, behaviors, perspectives, concepts, judgments, expectations and methodologies towards e-commerce that are shared by people and enterprises within the industry. It also includes all initiatives, actions and plans that develop knowledge and positive culture for e-commerce. A positive socio-economic and knowledge infrastructure must be required to support effectively e-commerce activities within the trading networks. Nowadays, psychological issues are considered as most serious barriers to e-commerce environment, especially in developing countries' context (Ruikar and Anumba, 2008; Schwartz and Davis, 1981; Egbu, 2008).

A SET OF CONTEXT-SPECIFIC MEASURES FOR THE PROPOSED FRAMEWORK

Strategy: Here's, purpose is to create the pools of measures for each constructs of the proposed framework to capture fully the nature of constructs as well as the unique characteristics of Vietnamese Construction Industry (VCI). A previous review of e-readiness models found that nearly all e-readiness studies did not provide information on how the indices were constructed, or how they might be adjusted to taking contextual differences into account (Maugis *et al*., 2005). In addition, the unique contextual characteristics of countries, industries or the demands for specific technology applications have been not paid appropriately attention in developing the instruments. According to Janom and Zakaria (2008), specific indices of barriers under each e-readiness variable to able to give a clearer theoretical foundation of e-readiness. From the suggestion, a three-step approach which is different from previous identifying methods, was used ("Research Methodology").

The pools of e-readiness measures: Firstly, based on characteristics, barriers and challenges to e-commerce of Vietnam construction industry, the authors developed a preliminary set of 66 contextual-specific measures (Appendix 1). There have also been fifty supplement items which were drawn from the PERM model (Molla and Licker, 2005a), the VERDICT model (Ruikar *et al*., 2006) and an integrated information-rich e-readiness assessment tool (Mutula and van Brakel, 2006). As a result, a set of 116 items categorized for each of the proposed constructs was generated. Finally, the set was refined to create a final set of 76 measures which is believed to capture best the essence of the constructs of the proposed framework as well as the unique characteristics of VCI. All of these items are listed in Appendix 2.

DISCUSSION AND CONCLUSION

This study is expected to develop a conceptual e-readiness assessment tool that is flexible enough to assist construction enterprises in developing countries to make their own effective action plan towards the entry-level adoption of Web-based e-commerce.

First, a conceptual e-readiness framework proposed in this present study is construction-industrial-oriented.

Comparison to VERDICT-an only existing e-readiness model that is also intended for the construction industry but in developed countries; the proposed framework is more powerful to assist enterprises in making an effective action plan because of its combination of both internal and external influential factors. Moreover, VERDICT includes only managerial, process, human and technological aspects without a consideration of information issue. Given skilled human resource, appropriate technology infrastructure, good management and integrated process; however, if it lacks information resource the system would not operate in an efficient manner. With appropriate consideration of the importance of information issue in both internal and external environment to the success of the initial implementation of e-commerce, the proposed framework shows its special attention on the information-based nature of Web-based innovations, such as e-commerce. This is clearly a notable advantage of the current model as compared to previous models.

Another valuable advantage of the present model is that the issues related to the social culture, industrial knowledge and industrial attitudes towards e-commerce are taken into account. As we know, psychological issues are considered as most serious barriers to e-commerce environment, especially in developing countries' context (Ruikar and Anumba, 2008; Schwartz and Davis, 1981; Egbu, 2008). Moreover, the construction activities are very often associated to the construction supply chains that are considered as a social and economic system with particular characteristics (i.e., are both fragmented and dynamic-consisting of relationships between firms of both collaboration and competition); so the integration of the supply chains will assist the successful implementation of e-commerce (London and Bavinton, 2006). Thus while it is important to be aware of the environmental supports to e-commerce (government commitments, legal system, technological and information infrastructures), our research focuses also on the importance of diffusion between businesses and the integration within the construction supply chains for the successful implementation of Web-based e-commerce.

Second, the set of e-readiness measures developed is expected to fully capture the essence of each construct of the proposed framework and the contextual characteristics of the construction industrial environment in Vietnam. This obviously makes the current model become more effective to assist Vietnamese construction enterprises in assessing their e-readiness situation towards the successful implementation of e-commerce. It is more valuable as the existing literature is lacking such a contextual-specific model.

It is also worth noting that the three-step approach that used to create the preliminary items pools in this study is different from common identifying methods previously used (Moore and Benbasat, 1991). The current method helps the identifying process of contextual characteristics-specific items was not suffered by the existing related instruments.

The further value of the study's results is also that:

- The e-readiness framework and the instrument proposed can be used to conduct preliminary assessments as well as analyze relationships between an individual enterprise's internal resources available for e-commerce and its top manager's perception of external e-commerce readiness. Such a research can help to answer whether or not there will be a covariance between the two variables. If a significant covariance exists across the industry, we can surmise is that providing special programs to improve enterprises' perception of the e-business infrastructures may be one of effective ways by which related government institutions can indirectly assist individual enterprises in successfully implementing e-commerce
- The results of this study can be also applied to help public administration institutions in evaluating the difference between the perceived external e-readiness by enterprises' top managers and the actual e-readiness picture of the industry. If there is a significant knowledge gap across the industry, then it seems that solutions that are to enhance companies' perception of the environment conducted by the institutions will become more crucial

For further research, in order to gain a ready-to-use e-readiness assessment instrument, scale development (i.e., assessment of the construct validity) and instrument testing (i.e., pilot test and full field test) need to be conducted in future.

It is also very worth noting that this present study is only intended to the e-commerce adoption/implementation at the initial phase. The e-commerce adoption is a complex and multi-phase process. The evolution of the strategic role of Web-based e-commerce technologies is closely linked to their sophistication because it reflects the way the technology is managed and used by a company. At a basic level, it can be said that in order to gain benefits and maximize potential advantages from e-commerce technologies, a firm must first accept, adopt, use and then internalize fully these technologies (Dada, 2006). In light of this, future studies on institutionalization of e-commerce technologies will be very important considerations for an understanding of the diffusion and improving success of e-commerce in the construction sector in developing country's context.

Appendix 1: The preliminary context-specific set of e-readiness items identified based on the unique characteristics of Vietuam construction industry

Characteristics and weaknesses of Vietuamese construction industry	References	The preliminary contextual specific measures for each construct of the proposed e-readiness framework
A complex and ineffective legal and institutional framework. Bureaucracy is one of the critical problems in the industry. A high rate of bribery and corruption in the industry.	Phan and Luu (2012), Tran *et al.* (2011a), Long *et al.* (2004),	• **LMI:** we believe that there has been an effective, comprehensive and well-docnmented legal and institutional framework which addresses traditional legal risks (e.g., cormption, bureaucracy, fraudulent, jurisdiction, etc.) to general construction activities
Inertia forces are still strong in the Vietuamese culture. The directive style is the common style of the Vietnamese thinking.	JETRO (2007) and Le-Hoai *et al.* (2010)	• **LMI:** We believe that government officials are highly ready in terms of knowledge of and positive attitudes towards IT and web-based e-commerce applications
There have been slackness, ineffectiveness and lack of IT knowledge of state officials;		• **LMI:** We believe that public administration institutions and state enterprises commitment and support strongly public e-commerce in general, such as public e-procurement
Adoption and implementation of public e-commerce technologies (i.e., e-procurement and e-bidding) are facing their "frigidity".`		• **SEKI:** We believe that socio-cultural environment is now supportive of e-commerce because of its active and independent style of thinking, working and managing in the industry
Industrial structure is characterized by SMEs which have small management teams, lack of staff in IT, limited control over their business environment, a reluctance to take risks and avoidance of sophisticated IT applications;	Phan and Luu (2012), Ca (2003), Long *et al.* (2010), Le-Hoai *et al.* (2010), Luu *et al.* (2008) and Nguyen *et al.* (2007)	• **LMI:** We believe that the industry has paid especially attention on SMEs in economic development • **SEKI:** We believe that industrial economic environment is now quite competitive, equal and transparent that is indirectly supportive for e-commerce • **SEKI:** We believe that the key trend of the industrial economic environment is now collaborative, cooperative and interactive • **HR:** Our enterprise has an operation management teams that can well implement and manage complex tasks • **HR:** We have IT specific staffs • **MR:** Our enterprise's management is always ready to face with risks to adopt innovation
The domestic market is mainly controlled by large and medium firms and they tend to operate independently. Major part of the industry originated from state-owned enterprises which receive more preferential support by government. This directly leads to that the industry environment lacks of competitive motivation. Labor structure is irrational (engineers/technicians/workmen = 1/1.3/3 in which reasonable ratio must be 1/4/10).		
Labor force is characterized by the predominance of migratory and nnskilled labor; number of labor was trained to provide construction sector about 25% of total labor.	Pham (2008) and Phan and Luu (2012)	• **SEKI:** We think that the industry's structure is now stable and quite reasonable that is supportive for e-commerce development • **SEKI:** Skilled labor force is available for the industry • **HR:** Our enterprise's labor force is now stable and skilled
Labor-intensive projects are mostly given to domestic contractors while such projects which need high technology, are nndertaken by foreign contractors. Contractor selection is ineffective; non-transparency and in-competitive. Construction projects in Vietnam now trend towards more flexibility, coordination, knowledge exchange and cooperation and it requires appropriate project information in terms of the quality of information and information flow, availability, supply of resources and the expertise of the consultants.	Phan and Luu (2012), Luu *et al.* (2008), Le-Hoai *et al.* (2008), Le-Hoai *et al.* (2010) and JETRO (2007)	• **BR:** We have been cooperating with foreign partners in some projects that support and encourage ourselves to adopt IT and e-commerce technologies • **TI:** We believe that industrial technological infrastructure is generally effective and efficient enough to support e-commerce activities in coordination, collaboration, cooperation and knowledge exchange • **IR:** Our enterprise's information management in supply chains is effective and flexible enough to support e-collaboration and e-exchange with partners within projects • **II:** We believe that industrial information sources is available, transparency and accessible equally • **SEKI:** We believe that industrial economic environment is now quite competitive, equal and transparent that is indirectly supportive for e-commerce • **SEKI:** We believe that the key trend of the industrial economic environment is now collaborative, cooperative and interactive
Lack of experience in complex projects; lack of project management ability; the estimation and change management is poor in Vietnamese construction industry. They also lack the ability to link issues of a complex problem to potential solutions. Lack of strong financial capacity; Lack of technicians, scientists and managers suitable for modern age construction sector is necessary. Cultural and technological knowledge management dimensions seem to make a nnique significant contribution to competitive advantages of a Vietnamese construction firm.	Ling *et al.* (2009), Long *et al.* (2004), Long *et al.* (2010), Luu *et al.* (2008), Le-Hoai *et al.* (2010), Pham (2008) and Nguyen *et al.* (2009)	• **MR:** Our enterprise's business and operation managers are skilled, experienced and capable of knowledge management that supportive for the estimation and change management • **BR:** We have enough finance to support implementing IT innovations and web-based e-commerce technologies • **SEKI:** We think that the industrial socio-economic and knowledge infrastructure has enough technicians, scientists and managers required for development general e-commerce strategy in the industry • **HR:** Our enterprise's organizational culture is incentive and supportive for e-commerce activities by its openness, creativeness, activeness, trust and sharing

Appendix 1: Continue

Characteristics and weaknesses of Vietnamese construction industry	References	The preliminary contextual specific measures for each construct of the proposed e-readiness framework
There is little expenditure on research and development in CI; The average expenditure of Vietuamese SMEs for this purpose accounts for only 0.2-0.3% of total revenue in comparison with 5% for Indian SMEs or 10% for Korean SMEs.	Ling *et al.* (2009) and Le-Hoai *et al.* (2010)	• **BR:** Our enterprise has had a special financial policy for IT development and research • **BR:** Our enterprise has had a special financial policy for particularly e-commerce strategy
E-commerce technologies were still in the early stages of implementation in most construction organizations.	VECITA (2009) and Tran *et al.* (2011a)	• **TI:** We believe that web-based e-commerce technologies have been implemented widely at different levels in the industry • **SEKI:** We think that enterprise community in the industry has positive attitudes towards web-based e-commerce
Enterprises were unsure of the precise benefits of e-business to their respective organizations and to themselves.	Tran *et al.* (2011a)	• **SEKI:** We believe that enterprise community in the industry is clearly aware of short-time and long-term benefits of web-based e-commerce technologies
Organizational culture issue and awareness of new technologies were main barriers for using e-commerce in CI.		• **HR:** Our enterprise's organizational culture is incentive and supportive for e-commerce activities by its openness, creativeness, activeness, trust and sharing
In 2010, it was a common view among industry practitioners whom the objectives for using e-business technologies in construction were not clearly defined, primarily due to a lack of a well-defined business process model that integrated e-business with the infrastructure and legacy systems of construction companies.		• **MR:** We are clearly aware of potential benefits and challenges of e-commerce to our enterprise • **BR:** We have carried out self-assessment and developed a well-defined business process model that can integrate e-business with legacy systems and business strategy of construction companies • **TR:** We have adopted and implemented effectively e-business applications that potentially support web-based e-commerce activities
The industry has accepted and adopted e-business applications that have minimal impacts on their processes and hence are easy to implement and use.		• **HR:** Our staffs have had good skills on the simple e-business applications
Internet security and ICTs infrastructure across networks were not seen as considerable barriers in Vietnam.	VECITA (2009) and Tran *et al.* (2011a)	• **TI:** We believe that issues that related to network security are overcome • **TI:** ICTs infrastructure has met the required level in terms of capability and performance to support e-commerce in CI
The infrastructure needed for IT and e-commerce application has started to stabilize and develop in depth that focused on human resource development.		

Characteristics of general e-commerce environment in Vietnam	References	Preliminary indexes intended to internet-based e-commerce e-readiness assessment
Leadership and management infrastructure: • Government commitment on e-commerce is quite strong • However, the state, judging by its policy actions, will not assume a pioneering role in facilitating the market demand for e-commerce • The role of government was not clear and distinct. It can be said that the state's role in accepting and implementing e-commerce was contradictory • Vietuam is committed to joining different free trade agreements such as e-ASEAN, APEC and the WTO. However, there is a difference between these commitments and the hesitant efforts that the government has made to realize e-commerce policies • There has no close linkages between policies and policy-making bodies, between domestic policies and international commitments, making the system fragmented • There were little consensus and harmonization among key institutions on the pace, extent, format and nature of e-commerce development • The weakest aspect seems to be the state's failure to create an environment that is conductive and supportive for development e-commerce by enterprises	VECITA (2009) and Ca (2003)	• **LMI:** We believe that the state commitment on e-commerce is clear, comprehensive and strong • **LMI:** We believe that government has an overall e-commerce vision of the economy rather than a specific priority targeted only on a number of industries • **LMI:** We believe that the state is playing a pioneering role in facilitating the market demand for e-commerce through public e-services • **LMI:** We believe that there has been a nationally and internationally unified and effective policy system that supported best to e-commerce by the government • **LMI:** We believe that the Government has also set up a special fund and financial policies to support SMEs that want to initiate e-commerce activities • **LMI:** We believe that the Government has paid much attention in developing e-infrastructure in remote, rural and poor areas to take up e-commerce • **LMI:** We believe that there has been a multi-sector, inter-ministerial advisory agency (with participation from ministries such as finance, banking, trade, justice, post and telecom and science and technology) to work on development of e-commerce

Appendix 1: Continue

Characteristics of general e-commerce envirounent in Vietuam	References	Preliminary indexes intended to internet-based e-commerce e-readiness assessment
Legal and regulatory infrastructure: • The legal framework for e-commerce is weak in the areas of taxation, customer protection, intellectual property rights, e-payment, public security and human-resource development • Lack of legal or regulatory documents related to e-commerce • The current policy envirounent, including the legal framework, does not take sufficiently into account the needs of private enterprises and needs of rural users • The non-specific nature of the legal and regulatory documents which are sometimes too general • The focus of the documents is not appropriate to the activities of e-commerce. The views expressed in the documents still represent a cautious or old mentality	VECITA (2009), Tran (2009) and Ca (2003)	• **LRI:** We believe that there has been an effective, comprehensive and well-documented legal and institutional framework on issues related to e-transactions, such as e-taxation, customer protection, intellectual property rights, e-payment, e-security and human resource development • **LRI:** We believe that there has been a nationally and internationally unified legal and regulatory system that supported well to e-commerce • **LRI:** The current e-commerce legal and regulatory system takes sufficiently into account the needs of both public and private enterprises as well as of SMEs
Technological infrastructure: Public e-services (such as e-communication, e-certificate service, electronic tax declaration and clearance, public e-procurement) are increasingly provided in terms of numbers, size and quality by public administration agencies. Infrastmctures (e.g., international agreements, policy, rules, technological tools and management methods; legal and technological standards) support for e-transactions security is paid much more attention by government. Lack of technological standardization was a considerable obstacle to users who were counecting to, or building up, a system. In 2008, 99% of surveyed enterprises have Internet counections, with 92% of enterprises use ADSL services, 6% have leased line and 1% uses dial-up method. However, 1% still has no internet connection. The situation of using websites by Vietnamese enterprises is very promised with about 49% of enterprises that have had websites or planned to develop their own websites in the near future. The rate of enterprises that take part in e-marketplace is significantly increasing. There have been about 12% of enterprises in 2008 have taken part in domestic and international e-marketplaces.	VECITA (2009) and Tran (2009)	• **TI:** We believe that Internet infrastructure is effective in terms of counectivity, spread, speed, performance and reliability • **TI:** We believe that there has been an industrially unified system of technological standardizations • **TI:** G2B e-initiatives have been developed (as e-communication, e-certificate service, electronic tax declaration and clearance, public e-procurement) • **TI:** B2B e-initiatives have been developed (websites, e-payment, e-marketplaces, e-hubs, etc.) • **TR:** We have been developing our own technological standards that are integrated with standard systems of the industry • **TR:** We connect Internet via ADSL and leased line • **TR:** We have our own websites
Information infrastructure: There a lack of information to analyze the impact of e-commerce. Information issues are receiving more attention in terms of awareness and practices by both public institutions and businesses. When companies need to be involved in networks with local partners, they find that some Internet counections are blocked without just cause. The situation of using websites by Vietuamese enterprises is very promised with about 49% of enterprises that have had websites or planned to develop their own websites in the near future. However, most websites have main functions of introduction, product promotion (about 86%), 38% allow ordering and only 3.5% accept e-payments.	VECITA (2009) and Tran (2009)	• **II:** We believe that public administration institutions have established effective economic and administration information databases in terms of content and accessibility that support effectively to e-commerce • **II:** We believe that enterprises in the industry have been more active in improving industrial information infrastructure in terms of content, quality, flow and accessibility • **II:** We believe that general knowledge information resources that could be vital for economic activities are open to every enterprise • **IR:** - IR: Information is electronically and paper-based collected, filtered, checked, cleaned, stored, security protected through a specific IT management regime • **IR:** Our enterprise has supportive policies and commitments to improving sharing information with partners, competitors and customers

Appendix 1: Continue

Characteristics of general e-commerce environment in Vietnam	References	Preliminary indexes intended to internet-based e-commerce e-readiness assessment
It seems that public administration institutions now acknowledge information as a source of knowledge for development rather as a threat to minimize the attitude of suspicion and hesitancy to share information, reduce information monopolies and increase the transparency and balance of information access within the economy and the society.		
Supporting industries infrastructure: E-payment facilities and non-cash payment services in 2008, the 2009-2010 period were developed strongly. In 2008, 99% of surveyed enterprises have Internet connections, with 92% of enterprises use ADSL services, 6% have leased line and 1% uses dial-up method. However, 1% still has no internet connection. However, Internet use in enterprises has experienced certain obstacles (obscure effectiveness; heavy costs; complicated technology; quality of Internet services; and security and safety).	VECITA (2009)	• **SII:** We believe that the financial system has been developed and improved well enough to handle electronic transactions • **SII:** We believe that telecommunications industry has been developed and improved in terms of policy and technology to well support e-commerce activities
Socio-economic and knowledge infrastructure: The Vietuamese socio-cultural and knowledge infrastructure is generally still not conducive to the introduction of e-commerce in business. Business commnnity is increasingly using e-commerce at different levels in terms of awareness, amonnt of investment and effectiveness. Electronic payment activities are continuously improved in aspects of infrastructure, tmst, transaction numbers and value and quality. The direct cash payments are widely used while the rate of electronic payments is still very small (3.5%). Customers prefer to pay by cash and to touch and see things before they pay. E-commerce diffusion is significantly increasing through e-commerce teaching activities by educational institutions. Although, these activities have been spontaneous and lacks of support from relevant state regulatory agencies and of links with industrial companies. The awareness of e-commerce common standards is also very low by businesses and even experts with only a small number of large enterprises have implemented technological standards.	VECITA (2009) and Ca (2003)	• **SEKI:** We believe that social culture for e-commerce in terms of truths and information and knowledge sharing has been improved positively • **SEKI:** Knowledge of innovation and e-business has been trained, shared and managed well through training programs and policies, professional forums and academic conferences between state agencies, education institutions and enterprises • **SEKI:** The awareness of e-commerce technological standards by businesses has been emphasized and improved

Totally, an initial set of 66 items identified based on characteristics of Vietnamese construction industry

Appendix 2: A final set of 76 e-readiness measurement items

Which one best describes your current Web-based e-Commerce status?

- Not connected to the Internet, no e-mail
- Connected to the Internet with e-mail but no website
- Simple e-Commerce that is publishing basic company information on the web without any interactivity
- "Communicative" e-Commerce that is accepting queries, e-mail and formal entry from users
- More sophisticated e-Commerce that is online selling and purchasing of products and services, including customer service that is the website is integrated with suppliers, customers and other back office systems allowing most of the business transactions to be conducted electronically

On the scale of 1 (strongly disagree) to 5 (strongly agree), indicate your level of agreement with the following statements.

Managerial resource of an enterprise (MR):

- **MR1:** Our enterprise's management is always ready to face with risks to adopt innovation
- **MR2:** Our enterprise's business and operation managers are skilled, experienced and capable of knowledge management supportive for the estimation and change management
- **MR3:** We have top management commitment towards and a clear-cut and comprehensive vision of web-based e-commerce innovation (*)
- **MR4:** We have IT management strategies that are properly appraised and they are considered to be incentive and supportive Internet-based e-commerce activities (*)
- **MR5:** Our organization has engaged in proactive tools, programs and policies that focus on creating a positive organizational culture that informs, equips and encourages staff to learn, adopt and adapt (*)
- **MR6:** We are clearly aware of potential benefits and challenges of e-commerce to our enterprise
- **MR7:** We have had a comprehensive strategic plan to implement Web-based e-commerce in near future (*)
- **MR8:** Generally, we have effective managerial resource that incentive and supportive for web-based e-commerce

Business resource of an enterprise (BR):

- **BR1:** We have been cooperating with foreign partners in some projects that support and encourage ourselves to adopt IT and e-commerce technologies
- **BR2:** We have enough finance to support implementing IT innovations and web-based e-commerce technologies
- **BR3:** Our enterprise has had a special financial policy for IT development and research
- **BR4:** Our enterprise has had a special financial policy for particularly e-commerce strategy
- **BR5:** We have carried out self-assessment and developed and are using a well-defined business process model that flexible enough integrate e-business with legacy systems and business strategy of construction companies
- **BR6:** Generally, we have effective business resource that incentive and supportive for web-based e-commerce

Human resource of an enterprise (HR):

- **HR1:** Our enterprise has an operation management teams that can well implement and manage complex tasks
- **HR2:** Our enterprise's labor force is now stable and skilled
- **HR3:** Our enterprise's organizational culture is incentive and supportive for e-commerce activities by its openness, creativeness, activeness, aggressiveness, trust and sharing
- **HR4:** Our staffs have had good skills and experience on the simple e-business applications
- **HR5:** We have IT specific staffs
- **HR6:** Generally, we have skilled human resource that incentive and supportive for web-based e-commerce

Technological resource of an enterprise (TR):

- **TR1:** We have provided computers and ICTs tools (*)
- **TR2:** We connect Internet via ADSL and leased line
- **TR3:** We have been using LAN in our organization (*)
- **TR4:** We have our own websites
- **TR5:** We have adopted and implemented effectively e-business applications that potentially support web-based e-commerce activities
- **TR6:** We have an IT specific managerial department or centre (*)
- **TR7:** Generally, we have a well-established and managed enterprise-wide technological infrastructure that incentive and supportive for web-based e-commerce

Information resource of an enterprise (IR):

- **IR1:** Information is electronically and paper-based collected, filtered, checked, cleaned, stored, security protected and shared through a specific IT management regime
- **IR2:** Information is early accessible and responsibly shared within our enterprise (*)
- **IR3:** Our enterprise's information management in supply chains is effective and flexible enough to support e-collaboration and e-exchange with partners within projects
- **IR4:** Our enterprise has supportive policies and commitments to improving sharing information with partners, competitors and customers
- **IR5:** Generally, we have a well-established and managed information infrastructure that incentive and supportive for web-based e-commerce

Leadership and managerial infrastructure within the industrial environment (LMI):

- **LMI1:** We believe that the state commitment on e-commerce is clear, comprehensive and strong
- **LMI2:** We believe that government has an overall e-commerce vision of the economy rather than a specific priority targeted only on a number of industries
- **LMI3:** We believe that the state is playing a pioneering role in facilitating the market demand for e-commerce through public e-services (e.g., public e-procurement, public e-bidding, e-taxation)
- **LMI4:** We believe that government officials are highly ready in terms of knowledge of and positive attitudes towards IT and web-based e-commerce applications
- **LMI5:** We believe that public administration institutions and state enterprises commitment and support strongly public e-commerce in general, such as public e-procurement
- **LMI6:** We believe that the government has been a nationally and internationally unified and effective policy system that supports best to e-commerce
- **LMI7:** We believe that the industry has paid especially attention on SMEs in economic development
- **LMI8:** We believe that the Government has set up a special fund and financial policies to support SMEs that want to initiate e-commerce activities
- **LMI9:** We believe that the Government has paid much attention in developing e-infrastructure in remote, rural and poor areas to take up e-commerce
- **LMI10:** We believe that there has been a multi-sector, inter-ministerial advisory agency (with participation from ministries such as finance, banking, trade, justice, post and telecom and science and technology) to work on development of e-commerce
- **LMI11:** Generally, we believe that managerial infrastructure is supportive and incentive to e-procurement implementation in construction industry

Legal and regulatory infrastructure within the industrial environment (LRI):

- **LRI1:** We believe that there has been an effective, comprehensive and well-documented legal and institutional framework which addresses traditional legal risks (e.g., corruption, bureaucracy, fraudulent, jurisdiction, etc.) to general construction activities
- **LRI2:** We believe that there has been an effective, comprehensive and well-documented legal and institutional framework on issues related to e-transactions, such as e-taxation, customer protection, intellectual property rights, e-payment, e-security and human resource development
- **LRI3:** We believe that there has been a unified legal and regulatory system to support well to e-commerce
- **LRI4:** We think that the e-commerce legal and regulatory system takes sufficiently into account the needs of both public and private enterprises as well as of SMEs
- **LRI5:** Generally, we have a well-established and managed legal and regulatory infrastructure that incentive and supportive for web-based e-commerce

Technology infrastructure within the industrial environment (TI):

- **TI1:** We believe that Internet infrastructure is effective in terms of connectivity, spread, speed, performance and reliability
- **TI2:** ICTs infrastructure has met the required level in terms of capability and performance to support e-commerce in the industry
- **TI3:** We believe that issues that related to network security are overcome via., security tools, such as electronic signatures and PKI
- **TI4:** We believe that web-based e-commerce technologies have been implemented widely at different levels in the industry
- **TI5:** We believe that there has been an across-industry unified system of technological standardizations

- **TI6:** G2B e-initiatives have been developed (as e-communication, e-certificate service, electronic tax declaration and clearance, public e-procurement)
- **TI7:** B2B e-initiatives have been developed (websites, e-payment, e-marketplaces, e-hubs, etc.)
- **TI8:** We believe that industrial technological infrastructure is, generally, effective and efficient enough to support web-based e-commerce activities in coordination, collaboration, cooperation and knowledge exchange

Information infrastructure within the industrial environment (II):

- **II1:** We believe that public administration departments have now positive attitudes towards information openness; they consider information as a source of knowledge for development (*)
- **II2:** We believe that across-industrial information sources is available, transparency and accessible equally
- **II3:** We believe that public administration institutions have established economic and administration information e-databases available and fair for enterprises which support effectively to e-commerce
- **II4:** We believe that enterprises in the industry have been more active in improving industrial information infrastructure in terms of content, quality, flow and accessibility
- **II5:** Generally, we have information infrastructure in the industry that incentive and supportive for web-based e-commerce

Supporting industries infrastructure (SII):

- **SII1:** We believe that the financial system has been developed and improved well enough in terms of IT infrastructure, process, policies and management to handle electronic transactions
- **SII2:** We believe that telecommunications industry has been developed and improved in terms of IT infrastructure, process, policies and management to support well e-commerce activities
- **SII3:** We believe that transportation industry has been developed and improved in terms of IT infrastructure, policies and management to well support e-commerce activities (*)
- **SII4:** Generally, we have supporting industries infrastructure that incentive and supportive for web-based e-commerce

Social-economic and knowledge infrastructure (SEKI):

- **SEKI1:** We believe that socio-cultural environment is now supportive for e-commerce because of improved trust on e-transactions, active and independent style of thinking, working and managing within the industry
- **SEKI2:** We believe that the key business trend in the industry is now collaborative, cooperative and interactive
- **SEKI3:** We believe that enterprise community in the industry is clearly aware of short-time and long-term benefit of web-based e-commerce technologies
- **SEKI4:** We think that enterprise community in the industry has positive attitudes towards web-based e-commerce
- **SEKI5:** We believe that economic environment is now quite competitive, equal and transparent that is indirectly supportive for e-commerce
- **SEKI6:** We think that the industry's industrial structure is now stable and quite reasonable that is supportive for e-commerce development
- **SEKI7:** Skilled labor force is available for the industry
- **SEKI8:** We think that there are enough technicians, scientists and managers required for the development of general e-commerce strategy in the industry
- **SEKI9:** Knowledge of innovation and e-commerce has been trained, shared and managed well across the industry. It is through training programs and policies, professional forums and academic conferences between state agencies, education institutions and enterprises
- **SEKI10:** E-commerce technological standards have been paid more attention by businesses
- **SEKI11:** Generally, socio-economic and knowledge infrastructure is incentive and supportive for web-based e-commerce

Notes: (*) The items are those which were added from the review result of existing e-readiness models (e.g., the PERM model, the VERDICT model and an integrated information-rich e-readiness assessment tool by Mutula and van Brakel (2006). Totally, there have been 10 items added.

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