E-Procurement Implementation in Malaysian Construction Industry

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ABSTRACT

Background: Electronic procurement (e-procurement) has been widely adopted across the industry, and as such various aspects of its adoption has been researched. The adoption of e-Procurement in the construction industry is not as widespread, and there has been limited research into the factors affecting the adoption of e-Procurement within this context. Objective: To examine and explore the influence of organizational resources and capabilities to the e-Procurement implementation in the construction industry. Results: The model elicits eight resources and capabilities grouped into three categories: organizational, environmental and technological. Findings based on multiple regression analysis indicate that factors such as competencies, trading partner readiness and trading partner power are significant determinants of e-Procurement values. Conclusion: These results imply that internal IT competencies and trading partner relationship will influence the e-Procurement values in the construction organization. Finding from this study may valuable for both policy and practice as it can offer a substantial understanding of the factors that enhance the widespread use of e-Procurement. Also, the integrated model provides a more comprehensive explanation of e-Procurement adoption in construction firms and could serve as a foundation for future research on information systems in construction management domain.

INTRODUCTION

The development of internet technology has profoundly changed the way construction industry does business. Value gains from e-Commerce applications, particularly e-Procurement, are well known and it has been accepted across industries (Anumba & Ruikar, 2008). However, the adoption of e-Procurement is considerably low in construction industry, which lags behind other industries such as manufacturing and retail industry (Alam & Ahsan, 2007; Mansor & Abidin, 2010; Pierre & Robert, 2010; Tan et al., 2009). Low adoption of e-Procurement in industry is attributed to the various areas required by e-Procurement investment (i.e. people, process and technology). Since e-Procurement is costly and adopting e-Procurement requires substantial changes in internal processes of organizations, an increase in the availability of information related to resources and capabilities required will be significant as one of the primary motivations for professionals in the industry to adapt to new technologies.

This paper aims to understand the resources and capabilities required for e-Procurement successful implementation and thus to provide a benchmark for future studies. This paper is constructed as follows, at the beginning: literature review and development of theoretical framework for e-Procurement in construction industry are overviewed. Then, the research methodology and findings from survey are presented and finally discussion of research findings and conclusion are presented.

Literature Framework: Resource Based View & Technological-Organisation-Environmental (TOE) Framework:

The resource based view (RBV) is a suitable theoretical framework for studying technological capabilities. RBV links organisational resources and capabilities with competitive advantage (Melville et al., 2004; Wu, 2010; Zhuang & Lederer, 2006). The RBV suggests that firms can achieve positive outcomes as long as they possess valuable, rare, imperfectly imitable and non-substitutable resources and capabilities (Barney, 1991). Therefore, analysing specific types of capabilities and resources and their relationships are ways to contribute to a better understanding of the sources of IT capabilities – IT based business values (Ravichandran & Lertwongsatien, 2005).

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Previous research has identified a large set of antecedents that can impact innovation usage. Depietro et al. (1990) developed a framework that succinctly categorizes these antecedents into three different contexts – technology, organization, and environment (TOE). It posits that in addition to the qualities of an innovation, there are broader contexts that significantly impact innovation adoption and use. The TOE framework has been widely used in the extant information system (IS) research. However, the TOE framework does not represent a well-developed theory; hence it does not provide the theoretical rationale to establish causal relationships. In contrast, individual theories lack the breadth of variables in the TOE framework, and its simple classification. Thus, recent literature in IS has attempted to combine the best attributes of the TOE framework with other theories (Zhu & Kraemer, 2005). To explain what resources and capabilities may shape the value of e-Procurement; this paper adopted the TOE framework directly. This framework identifies three aspects of a firm that influence the process by which it adopts and implements technological innovation: technological context, organisational context and environmental context (Tornatzky et al., 1990). These three groups of factors influence a firm’s intent to adopt new innovation, affect the follow-up assimilation process, and later impact organizational performance.

**Development of Hypothesis:**

The research model for this study was developed by examining the RBV theory and Information Systems literature and adoption and diffusion research. In this paper, the model focuses on four constructs: technological, organisational, environmental and e-Procurement value.

On the basis of existing literature and previous Malaysian-based studies on the usage of technology, a one-stage normative model was developed which provides the basis of research objectives. This normative model, shown in Figure 1, is a one-stage model that relates the independent and dependent variables without any intervening variables. The relationship shown in the model is associated rather than casual in nature. In this study, the value of e-Procurement is the dependent variable and there are eight independent variables grouped into three categories. The following framework with three dimensions of sources is applied for this purpose:

**Organization:**
- Top Management Support and Competencies

**Technology:**
- Infrastructure Information Technology and IT-business alignment

**Environment:**
- Competition Intensity, Trading Partner Readiness, Trading Partner Power-Dependence

Technology resources refer to internal and external technology (Zhu et al., 2004) owned by firms. Previous studies have shown that technology resources were the main contributors of IS success implementation (Melville et al., 2004; Ramlah et al., 2007). Ada et al. (2012) in their meta-analytic studies across various types of information systems also shown that utilisation of technology resources is positively significant with firm’s performance. For this paper, information technology infrastructure and IT-business alignment were selected as the resources under technology context.

**H1:** Information Technology Infrastructure is positively significant with e-Procurement value

**H2:** IT-Business Alignment is positively significant with e-Procurement value

![Conceptual Model](image.png)

Fig. 1: Conceptual Model.

Organisational resources can be referred to as the internal resources and capabilities that influence the IS implementation in the firms. It may consist of firms’ size, management structure, qualities of human resources
and amount of slack resources. Prior studies has identified that organisational resources compliment the technology resources in order to gain the maximum value from IS implementation (Kearns & Lederer, 2003; Melville et al., 2004; Wu, 2010). For this paper, top management support and current level of competencies are selected as complimentary resources that influence the e-Procurement value.

**H3:** Top Management Support is positively significant with e-Procurement value

**H4:** Competencies is positively significant with e-Procurement value

Environmental context refers to the external resources and capabilities that can influence the implementation of IS. Previous studies related to inter-organisational systems (IOS) indicate that the firm’s ability to utilise the value of IS heavily depends on the trading partner’s supports and market where business operates (Chang & Chen, 2005; Melville et al., 2004; Zhuang & Lederer, 2006). Three external factors were selected as external resources and capabilities in this study that are trading partner readiness, trading partner power and competition intensity. The next section will explain on the research design and operational construct for the selected variables.

**H5:** Trading partner readiness is positively significant with e-Procurement value

**H6:** Trading partner power is positively significant with e-Procurement value

**H7:** Competition intensity is positively significant with e-Procurement value

**Methodology:**

A structured questionnaire consisting of closed-ended multiple choice questions was employed for the study. Given that most of the items in the questionnaire are targeted at measuring perceptions, a Likert-type scale was considered the most appropriate and reliable method (Sekaran & Bougie, 2010). This instrument measures key variables of the research using a 5-point Likert-type rating scale, ranging from strongly disagree to strongly agree. The recommendations of Visser et al. (1996) influenced the selection of the 5-point Likert scale. They argued that a range between 5 and 7 is established to be reliable, and a bipolar construct 7-point scale is the most favourable. This is because a scale with more points enables respondents to express their stand precisely and comfortably. Moreover, such a scale enables the researcher to make subtle distinctions among the attitudes of various individuals regarding a particular object or subject.

The questionnaire of this research is made up of three main sections. Section A consists of a set questions that seek the perceptions of respondents regarding antecedents to e-Procurement business values that are: top management support, competencies, strategic alignment, information technology infrastructure, trading power dependence, trading partner readiness and competition intensity. Section B comprises of four main questions targeted at measuring the e-Procurement usage intensity in the firms. Section C is made up of a total of 45 items which attempt to measure the firm’s performance using e-Procurement value items. Only relevant research questions will be included in the questionnaire, while sensitive questions are excluded in order to elicit a high response rate (Sekaran & Bougie, 2010).

The survey used for data collection was pretested with two procurement managers and seven PhD students and academic staff members before the official administration. The survey questionnaire was sent to 850 CEOs who forwarded it to the senior executives responsible for e-Procurement in their companies. The list of companies and the corresponding executives was obtained from the Construction Industry Development Board directory. As larger companies tend to have more resources and a more focused effort to the use of e-Procurement, companies with capital contributions of RM 1 million or more were selected. Three rounds of mailings were carried out and 190 responses were received. The final usable response rate was 20%, which was consistent with previous studies (Akintoye & Fitzgerald, 2000; Fellows & Liu, 2009).

A range of demographic characteristics was analysed from the extracted data subset (Table 1). The majority of the respondents held a job title of managing director or CEO or general manager. Furthermore, the respondents had an average of 11 and 20 years of experience in the industry. The length of a manager’s tenure gave some reassurance on the validity of the sample, since they were more likely to be knowledgeable about the strategies and activities of the companies. Most organizations had a workforce of 50 – 100 employees. In terms of e-Procurement experience, a majority of the companies had been using the applications for more than 5 years.

In evaluating the possibility of non-response bias, a formal procedure was used to compare early respondents with late respondents (Armstrong & Overton, 1977). The premise underlying this approach is that, in comparison to those firms responding early, late respondents are more likely to be similar to non-respondents. Using a one way analysis of variance procedure, no significant differences between groups were detected on any of the variables examined in this study. Thus, non-response bias was deemed to be of insignificant in this research.

**RESULTS AND DISCUSSION**

**Scale Reliability and Factor Analysis:**

The reliability of the questionnaire was tested using Cronbach α measurements. The reliability coefficients (α) of each independent variable are as follows: TMS (0.876); SI (0.815); COMP (0.866); ITI (0.694); TPR
Construct validity is assessed by factor analysis in this research. All items are examined by principal components extraction with varimax rotation. The Kaiser-Meyer-Olkin (KMO) has a measure of 0.840 (resources and capabilities) and 0.736 (e-Procurement value, which is above the threshold of 0.5 (Field, 2009). The Bartlett’s test is significant in this study (p-value < 0.001). Therefore, the KMO value of 0.840 and 0.736 and significance of Bartlett’s statistic confirm the appropriateness of the factor analysis for the data set.

Results on factor analysis test showed that all items are sorted and clustered into seven components: Factor 1 (TMS), Factor 2 (SI), Factor 3 (ITI), Factor 4 (TPR), Factor 5 (TPD), Factor 6 (CI), and Factor 7 (COMP). For the dependent variables (EPV), all items are loaded into three factors. These factors were labeled as Factor 1 (Strategic Value), Factor 2 (Operational Value) and Factor 3 (Tactical Value).

The eigenvalue for each factor is greater than 1.0, which implies that each factor can explain more variance than a single variable. The cumulative percentage of variance explained by seven factors is 72.71 percent. In other words, more than 70 per cent of the common variance shared by all items can be accounted for or explained by these seven factors. Based on the above results, the construct validity is established. Due to restriction of pages, this paper will not provide the table of results for the factor analysis in this research.

**Definition of Variables:**

Table 2 below indicates the previous literature from which the scales and constructs from the model are drawn.

**Hypothesis Testing:**

Table 3 presents the results from the multiple regression for independent variables sets (top management support, competencies, strategic alignment, information technology infrastructure, power-dependence, trading partner readiness and competition intensity) and for the independent variable (e-Procurement value).

In order to test for multicollinearity among the predictor variables, variance-inflation factor (VIF) and tolerance were applied. The multicollinearity statistics showed that the tolerance indicators for all predictors are all greater than 0.2, and their VIF values are less than 10. The F-Statistics produced (F=23.39) was significant at 1 percent level (Sig. F<0.01), thus confirming the fitness for the model. Therefore, there is a statistically significant relationship between the resources and the business performance. The variables combined explained the 39.3 per cent of e-Procurement value variance and the estimated 37.6 percent of variance in population (using adjusted R2, which estimates population effects based on sample degrees of freedom). Thus, the resources can significantly account for 37.6 percent in e-Procurement value.

The results shows that only three sources of relationship with e-Procurement value were supported (H2, H4 and H5 were confirmed). Surprisingly, a lot of factors did not have the expected relationship with e-Procurement value. Trading partner readiness, power on trading partner and competencies owned are the significant factors to the e-Procurement value. Trading partner readiness was found to have a significant negative relationship with e-Procurement value. This implied that the lower trading partner readiness, the higher
the value of e-Procurement. A possible explanation for this could be the flexibility level of the system owned by the trading partner. If the system cannot be integrated between the companies, the chances for the trading partner to have a business using e-Procurement become lower.

Table 2: Items for Research Variables.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Variables</th>
<th>Definition</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational</td>
<td>Top Management Support (TMS)</td>
<td>Top management involvement in allocating resources and setting the direction of the IS implementation</td>
<td>(Ifinedo, 2008; Ragu-Nathan et al., 2004)</td>
</tr>
<tr>
<td></td>
<td>Competencies (COMP)</td>
<td>The ability to use appropriate knowledge and skills in relation of IS implementation</td>
<td>(Hsu-Fen, 2008; Krammergaard &amp; Rose, 2002)</td>
</tr>
<tr>
<td>Technological</td>
<td>Information Technology Infrastructure (ITI)</td>
<td>The extent to which the information systems are structured or dispersed throughout an organization.</td>
<td>(Ramlah et al., 2007; Zhu &amp; Kraemer, 2002)</td>
</tr>
<tr>
<td></td>
<td>IT-Business Alignment (SI)</td>
<td>The extent to which IT strategy supports and is supported by the business strategy</td>
<td>(Chun-I Philip Chen, 2010; Kearns &amp; Lederer, 2003)</td>
</tr>
<tr>
<td>Environmental</td>
<td>Power (TPD)</td>
<td>The firm’s ability to influence trading partners to use e-Procurement</td>
<td>(Lee &amp; Lim, 2003; Premkumar &amp; Ramanurthy, 1995)</td>
</tr>
<tr>
<td></td>
<td>Trading Partner Readiness (TPR)</td>
<td>Readiness of partners to adopt the technology</td>
<td>(Chang &amp; Chen, 2005; Hsu-Fen, 2008)</td>
</tr>
<tr>
<td></td>
<td>Competition Intensity (CI)</td>
<td>Pressures caused by other firms in the market</td>
<td>(Porter, 1985; Zhu &amp; Kraemer, 2005)</td>
</tr>
</tbody>
</table>

Table 3: Multiple Regression Analysis.

<table>
<thead>
<tr>
<th>TOE and e-Procurement value</th>
<th>e-Procurement value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Management Support</td>
<td>0.020</td>
</tr>
<tr>
<td>Competencies</td>
<td>0.119**</td>
</tr>
<tr>
<td>IT infrastructure</td>
<td>0.072</td>
</tr>
<tr>
<td>IT-Business Alignment</td>
<td>0.072</td>
</tr>
<tr>
<td>Trading Partner Readiness</td>
<td>-0.080*</td>
</tr>
<tr>
<td>Trading Partner Power</td>
<td>0.267**</td>
</tr>
<tr>
<td>Competition Intensity</td>
<td>0.095</td>
</tr>
<tr>
<td>R</td>
<td>0.627</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.393</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.376</td>
</tr>
</tbody>
</table>

Notes: ** p < 0.001, * p < 0.05

Discussion:

In this study, we drew from resource-based theory to examine how IS resources and capabilities affect firm performance. We found that variation in firm performance is explained by the competencies of employee, trading partner readiness and trading partner power. The results provide empirical support for the notion that e-Procurement has the potential to improve firm performance when internal and external competencies are higher. Analysis also shows that to have a successful implementation of e-Procurement, the support and involvement of trading partner are the main factor for the success implementation. However, the negative relationship indicates that the lower the readiness that trading partner has will increase the chances of e-Procurement success. This may be due to trading partner can easily follow the requirement of the firm in setting up the infrastructure required by the firm. If the infrastructure required by the firm is simple, the chances to get support from the trading partner are higher. The acceptance of trading partner to connect with firm also related with the power imposed by the firm towards them. The higher power related with the resources and bargaining owned by the firm, the higher tendency for trading partner to join any innovations introduced to them.

Results also shows that the IT competencies owned by the firm will increase the firm performance. For this study, technical competencies owned by the firms were selected as the main important resources that can affect the business performance. The dependence with external consultant on the development and implementation of information system does not necessarily will guarantee the success of its implementation. The basic IT skill and knowledge posit by the employees are much more important since they are the main operators of the system. This finding is similar to the Ifinedo (2008) that highlight the role of external consultant which is to ease the system implementation in the firm and employee’s IT skill are much more important for the system implementation.

Other predictors in this research were found as not significant with the e-Procurement value. We presume that there are other variables that mediates the relationship among resources and e-Procurement value that is e-
Procurement capabilities. This resource needs to be developed and integrates to be transformed into capabilities. These capabilities will later impact the e-Procurement value of the firm.

Conclusions:
The purpose of this study is to investigate resources and capabilities affecting e-Procurement value in Malaysian construction firm context. This study also contributes to and extends our understanding of the internet as a medium for commercial use in the construction industry arena, identifying the internal and external resources of the e-Procurement by the construction firms.

The research was done under resources based theory and technology-organisational-environmental framework. Sources and capabilities required for the e-Procurement implementation were grouped under TOE framework. The multiple regression analysis shows that competencies trading partner readiness and trading partner power were useful predictors. All other sources and capabilities turn out to be not as useful predictors for construction firm in Malaysia.

Limitations & Future Research:
As with any empirical research, there are limitations to this study. First, a cross-sectional design is a limitation because results are usually more robust if an observation is made over time, rather than as a snap-shot in time. Second, sample size is another limitation. Although, the number of data used is adequate, it is expected that the result is more precise if the sample size is larger. The use of a single-informant to answer the questionnaire is a third limitation. Adding the opinion of the users of the different levels could be interesting for future research and will validate the answers and results obtained in this paper. The construct of performance is measured using different types of subjective indicators. Although the use of multi-item scales is generally accepted, future research is encouraged to identify more objective indicators. Finally, it is possible that the results reported here may have been influenced to some extent by measurement error introduced in the analysis, due to reliance on data reported by a single, though well-informed source (respondent) in each company.

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