Factors Affecting E-Tendering Process Based on The Perceptions of The Contractors Being Involved in The Tadulako University’s Construction Projects

Donny M. Mangitung¹ and Diah E. Novitasari²

Abstract

E-tendering can reduce processing time, cost of transport and proposed tendering document. However, the implementations of e-procurement still have some constraints, such as a lack of human resources related ICT (Technology, Information and Communication) expertise, limited internet connections, construction firm unpreparedness to face the implications of digital change. To identify the constraints, the questionnaire survey was designed for eliciting data with regard to twenty five variables affecting e-tendering process using a Likert scale of 6. Forty three questionnaires were distributed to contractors being involved in the e-tendering of Procurement Service Unit (PSU) at Tadulako University (Untad) in the period of 2012. Of the distributed sample, 35 respondents returned the questionnaires. The data were analyzed using the Factor Analysis technique and the results show that the factors are grouped into six determinant factors consisting of reliability and performance of ICT infrastructure for e-tendering services; personnel knowledge of Procurement Service Unit (PSU) in e-tendering procedures; regulation knowledge for e-tendering; webpage connections reliability; electricity supply performance; and sufficient and suitable knowledge and hardware systems for e-tendering process.

Keywords: e-tendering, contractors, Factor Analysis, public sector, Indonesia

Introduction

E-procurement has been widely practiced in Indonesia, especially in the public sector, since the President Regulation No. 54 (2010) introduced e-procurement of certain goods and services as a mandatory procurement method, before 2010 it was voluntary nature. This type of electronic transaction was adopted from e-business and e-commerce due to the rapid change in the use of information, communication and technology (ICT) (Walker and Harland 2008).

E-tendering in the construction industry is a type of various e-procurement forms which is a procedure of the contractor selection in order to find a competence contractor enlisted in Procurement Service Unit (PSU) using internet based Information and Communication and Technology (ICT) infrastructures or on the basis of electronic transaction through internet and expects to reduce face to face transaction as well as collusion (Vaidya, Sajeev and Callender 2006, Walker and Harland 2008, President Regulation No. 54 2010). Through e-tendering the process of contractor selection is considered a suitable mechanism to select a proper contractor fairly, efficiently and productively (Betts et al. 2006, Oyediran and Akintola 2011). In tendering stage, it becomes the most critical and important phase of the construction project life cycle, when this phase the project owner and contractor will enter

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into contractual and legal agreements (Vaidya, Sajeev and Callender 2006, Lou and Alshawi 2009).

Although, e-procurement or e-tendering has the values of transparency, efficiency and transparency and aims to increase transparency and accountability; improving market access and fair competition; improve the efficiency of procurement processes; support the process of monitoring and auditing; and meet the needs of real-time information access (President Regulation No. 54 2010). In practice, the implementations of e-procurement still have some constraints, such as a lack of human resources related ICT expertise, limited internet connections, construction firm unpreparedness to face the implications of digital change (Walker and Harland 2008, Anton 2010, Asnudin 2012).

Furthermore, there are two categories of critical success factors in respect of e-tendering process, namely, human and technology categories. Human category dependent on human behavior and expertise consists support management; business case; user uptake and training; project management; supplier adoption aspects, while technology category dependent on construction and deployment technologies is related to reliability; availability; efficiency; and interoperability aspects (Vaidya, Sajeev and Callender 2006, Lou and Alshawi 2009). Moreover, understanding of legal rules and principles become important factors in order to make security compliance for e-tendering and to minimize fraud and collusion inside and outside of the process (Betts et al. 2006, Eadie, Perera and Heaney 2010).

However, attention should be given to the human issues than technology ones, especially when there is a conflict between the two (Vaidya, Sajeev and Callender 2006). Factor related to human issues such as free training to employees, readily available resources and top management support in ensuring job security should be solved first when initial introduction of e-tendering, while technology issues are only as a tool for data and accelerate communication process ( Lou and Alshawi 2009).

In order to examine e-tendering process in the construction industry, especially in public sector projects, this paper will focus on identification of factors affecting e-tendering process based on the perceptions of the contractors being involved in the Tadulako University’s construction projects. The results may give better understanding and be interest to construction organization in order to improve e-tendering practices.

Data and Methodology

A questionnaire survey was conducted among the construction firms enlisted in the Procurement Service Unit (PSU) at Tadulako University (Untad). The questionnaire survey was designed for eliciting data with regard to twenty five variables affecting e-tendering process using a Likert scale of 6. 43 questionnaires were distributed and 35 were completed and returned, giving a 81% response rate. The returned questionnaires represent 8 large construction firms (23%) and 20 (57%) and 7 (20%) medium and small firms respectively. Moreover, about 74% (26) respondents have been involved in e-tendering for 2 years and less an only 14% (9) for 3 years.

These data in the Novitasari (2013) previous report were analyzed on the basis of Relative Rank Index (RRI) techniques and show that the top 5 variables from high to low ranks of RRI affecting the e-tendering process are adequate dissemination and training of e-tendering procedures and requirement (0.857); reliability of contractor computer systems and networks for involving in e-tendering (0.838): more opportunities of e-tendering services than traditional ones (0.833); internet connection reliability for e-tendering services (0.824); and routine maintenance of ICT systems for e-tendering (0.810).

However, these results cannot provide better understanding multiple relationships among 25 variables. The usage of Factor Analysis (FA) technique may improve the understanding not only of the important variables affecting weighting but also of the complex relationship
among variables. In addition, particularly when employing the FA technique, the data structure can be reduced and grouped into less determinant factors (Hair jr et al. 1998). In addition, the FA technique commonly used in the built environment and can be found in. While the usage of the FA technique in the built environment can be found in (Kaming, Olomolaiye and Holt 1997, Akintoye 2000, Awakul and Ogunlana 2000, Mangitung and Emsley 2002, Soetanto and Proverbs 2002, Lowe and Parvar 2004, Mangitung 2010).

**Results and Discussion**

**Factor Analysis results**

To analyze sample data using the FA technique is necessary to follow this procedure (Sharma 1996, Hair jr et al. 1998, Bryman and Cramer 2001, Mangitung 2010):

- First stage is FA objectives. In this case, it is to identify the structure of the relationships among variables affecting e-tendering process based on contractors’ perceptions. In other words, to summarize the information in the original variables to a small set of composite dimensions or variates (factors) with minimum loss of information;

- Second stage is FA design. The data have to be tested for the level of data reliability on the basis of Cronbach’s alpha coefficient ranging from 0 to 1 and the coefficient of less than 0.6 is considered poor, those in the 0.70 range acceptable and those over 0.80 good (Sekaran 2003). For this sample, the coefficient reveals in the acceptable range (0.762). Moreover, the adequacy of the sample size determined in order to provide an adequate basis for the calculation of the correlation between variables;

- Third stage is FA assumptions. The Bartlett Test of Sphericity (BTS), a statistical test for the presence of correlations among variables, must be examined, as well as the Measure of Sampling Adequacy (MSA) that measures the degree of intercorrelation among variables, using an index ranging from 0 to 1, which may be classified as unacceptable (≤0.5), miserable (0.5+), mediocre (0.6+), middling (0.7+), meritorious (0.8+), marvelous (≥0.9). The first running of FA, the MSA value is less than 0.5. In order to increase the MSA, it is necessary to reduce the variables which have smallest values of anti image correlation (Hair jr et al. 2008). In this case, variables of F3, F18 and F19 are eliminated. Then, the score of MSA become 0.526 (miserable but accepted). For BTS score is significant (see Table1);

- Fourth stage is deriving factors and assessing overall fit. The Principal Component Factoring (PCF) technique is used in this case for estimating the shared variance being extracted by the factor solutions, as the communalities of 14 variables are in the range from 0.70 to 0.90. The data reveals that six retained factors have latent roots or eigenvalues more than 1 indicating that the top six largest percentages of individual variances are considered significant. In addition, the data exhibits around 70% of the variances from six factors combined. It means that six factors are loaded together with around 70% of the variance (see Table 1).
Table 1 Rotated component factors using varimax orthogonal rotation

<table>
<thead>
<tr>
<th>Variables</th>
<th>Factor loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>F5-Ability to run application of e-tendering</strong></td>
<td>0.82</td>
</tr>
<tr>
<td><strong>F9-Internet connection reliability for e-tendering services</strong></td>
<td>0.78</td>
</tr>
<tr>
<td><strong>F12-Routine maintenance of ICT systems for e-tendering</strong></td>
<td>0.78</td>
</tr>
<tr>
<td><strong>F22-Providing detail and clear explanation of tendering documents</strong></td>
<td>0.86</td>
</tr>
<tr>
<td><strong>F10-Providing application for securing e-tendering services</strong></td>
<td>0.82</td>
</tr>
<tr>
<td><strong>F23-Experienced tender committee</strong></td>
<td>0.72</td>
</tr>
<tr>
<td><strong>F2-The level of understanding of the regulation of e-tendering</strong></td>
<td>0.85</td>
</tr>
<tr>
<td><strong>F1-More opportunities of e-tendering services than traditional ones</strong></td>
<td>0.69</td>
</tr>
<tr>
<td><strong>F17-Failure to download data during e-tendering process</strong></td>
<td>0.83</td>
</tr>
<tr>
<td><strong>F16-Failure to upload data during e-tendering process</strong></td>
<td>0.82</td>
</tr>
<tr>
<td><strong>F20-Experience with failure to upload data due to blackout</strong></td>
<td>0.90</td>
</tr>
<tr>
<td><strong>F21-Experience with failure to download data due to blackout</strong></td>
<td>0.85</td>
</tr>
<tr>
<td><strong>F7-Adequate dissemination and training of e-tendering procedures and requirement</strong></td>
<td>0.89</td>
</tr>
<tr>
<td><strong>F8-Reliability of contractor computer systems and networks for involving in e-tendering</strong></td>
<td>0.77</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eigen value</th>
<th>5.3</th>
<th>3.1</th>
<th>2.2</th>
<th>1.9</th>
<th>1.5</th>
<th>1.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of variance explained</td>
<td>25.4</td>
<td>15.0</td>
<td>10.5</td>
<td>8.9</td>
<td>7.4</td>
<td>6.1</td>
</tr>
<tr>
<td>Cumulative percentage of variance explained</td>
<td>25.4</td>
<td>40.4</td>
<td>50.9</td>
<td>59.8</td>
<td>67.1</td>
<td>73.2</td>
</tr>
</tbody>
</table>

Kaiser-Meyer-Olkin Measure of Sampling Adequacy= 0.526
Bartlett's Test of Sphericity= 427.660, significance p=0.000

- Fifth stage is to interpret the factors. For this data, rotated factor loadings are used the orthogonal rotation/varimax method, as component or extracted factors correlation coefficients are relatively independent (Field 2000). As a result of the rotation, as seen in Table 2 the variables group into six separated factors and load on each factor. The
chosen factor loadings are equal or greater than 0.70, each of six factors represent from two to three variables.

- Sixth stage is to name the factors. Labeling of the factors is based on an intuitive approach, where each name should accurately reflect the variables with higher loadings on a particular factor. In other words, a factor’s name can represent the characteristics of the variables loading on the particular factor (Sharma 1996, Hair jr et al. 1998). For clarity, the variables affecting the weighting are grouped into the six factors under new names as seen in Table 2.

Table 2 Summary of factor labeling

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Personnel knowledge of Procurement Service Unit (PSU) in e-tendering procedures</td>
</tr>
<tr>
<td>2</td>
<td>Regulation knowledge for e-tendering</td>
</tr>
<tr>
<td>3</td>
<td>Webpage connections reliability</td>
</tr>
<tr>
<td>4</td>
<td>Electricity supply performance</td>
</tr>
<tr>
<td>5</td>
<td>Sufficient and suitable knowledge and hardware systems for e-tendering process</td>
</tr>
<tr>
<td>6</td>
<td>Reliability and performance of ICT infrastructure for e-tendering services;</td>
</tr>
</tbody>
</table>

Discussion of Determinant Factors

Reliability and performance of ICT infrastructure for e-tendering services (Factor-1)

Factor-1 groups ability to run application of e-tendering; internet connection reliability for e-tendering services; and routine maintenance of ICT systems for e-tendering variables into one factor and represents 25.4% of the variance explained as seen in Table 1. This factor is not surprising that three variables are loaded together, as reliability and performance of resources including human resources’ competence is an important factor to improve the e-tendering process. This factor becomes one of the important issues due to the direct impact on the process of e-procurement performance, and a critical success factor for the development and adoption of e-procurement system (Croom and Brandon-Jones 2005). In addition, Rahayu, Saleh and Prasetyo (2013) found that the people and technology factors become major barriers based on the study in Electrical Power Supplier Company owned by government in Indonesia. Regarding technology factor is necessary to assess the hardware and software prior to installation and interoperability software in use in the both sides, namely, project owners and contractors (Eadie, Perera and Heaney 2010).

Personnel knowledge of PSU in e-tendering procedures (Factor-2)

Factor-2 grouping is made of providing detail and clear explanation of tendering documents; providing application for securing e-tendering services; and experienced tender committee variables. This factor represents 15% of the variance explained (see Table 1). This is also not surprising that three variables are loaded together that the human resources in the side of client of project owner, especially in the PSU are necessary to have competence and best practices in e-procurement services in order to accomplish procurement and project objectives. Knowledge sharing, training and development coordination influence on the successful e-procurement process (Croom and Brandon-Jones 2005).
The regulation knowledge for e-tendering (Factor-3)

Factor-3 grouping consist of the level of understanding of the regulation of e-tendering, and more opportunities of e-tendering services than traditional ones variables representing 10.5% of the variance explained as seen in Table 1. This factor is important for both sides of e-procurement services in order to reduce conflict between them (i.e. procurement user and provider), when the increase significantly the usage of electronic transaction. In addition, strong knowledge of e-procurement systems in the public sector become a key for the future success in this field (Vaidya, Sajeev and Callender 2006) and also sufficient understanding of legal rules and principles can minimize fraud and collusion by both parties (Betts et al. 2006).

Webpage connections reliability (Factor-4)

Factor-4 grouping comprise of failure to download data during e-tendering process; and failure to upload data during e-tendering process variables representing 8.9% of the variance explained (see Table 1). It is not surprising that internet connection in developing countries like in Indonesia is still one of constraint factors to implement e-tendering successfully. Similar to this constraint factor, Oyediran and Akintola (2011) identified poor telecommunications infrastructure and lack of interoperability of software in use by construction industry professionals, respectively as rank 3 (with mean value of 3.17 on the basis of scale of 4) and rank 8 (2.54).

Electricity supply performance (Factor-5)

Factor-5 groups experience with failure to upload data due to blackout; and experience with failure to download data due to blackout variables representing 7.4% of the variance explained as seen in Table 1. This factor is also important to exchange data via internet that need continue electrical supply and sufficient back up of electricity power, where many parts in Indonesia still have shortage of electricity supply including in the Central Sulwesi province. This constraint factor is also identified in the similar study in Nigeria as a highest rank (no. 1 with mean value of 3.32), where irregular electric power supply has become major concern in the construction business for many years in Nigeria (Oyediran and Akintola 2011).

Sufficient and suitable knowledge and hardware systems for e-tendering process (Factor-6)

Factor-6 grouping is made of adequate dissemination and training of e-tendering procedures; and requirement, reliability of contractor computer systems and networks for involving in e-tendering variables representing 6.1% of the variance explained (see Table 1). It is not surprising that this factor becomes important one in e-procurement or e-tendering process due to rapid culture change form manual to ICT based transaction process and also frequent changes in regulations. Moreover, sufficient and suitable knowledge for e-tendering process is key important factor to sustain in business in the construction industry (Vaidya, Sajeev and Callender 2006, Oyediran and Akintola 2011, Asnudin 2012, Rahayu, Saleh and Prasetyo 2013).

Conclusions

It can be concluded in this empirical study that the factors affecting e-tendering process based on the perceptions of the contractors being involved in the Tadulako University’s construction projects are consisting of reliability and performance of ICT infrastructure for e-tendering services (factor 1); personnel knowledge of Procurement Service Unit (PSU) in e-tendering procedures (factor 2); regulation knowledge for e-tendering (factor 3); webpage connections reliability (factor 4); electricity supply performance (factor 5); and sufficient
and suitable knowledge and hardware systems for e-tendering process (factor 6). Those factors included in human category are factor 2, 3 and 6, while technology category is relevant to factor 1, 4 and 5.

However, these findings have limitation due to the small sample size, the data based on contractors’ perceptions only without a user perceptions, and also data source on the basis of one organization, namely Tadulako University as state owned higher education. It is necessary to extend the sample domain and increase sample size to obtain broader picture regarding e-procurement issues.

Moreover, the identified factors have local unique issues such as, electricity supply problems and webpage connections reliability, where these issues are not dominant problem in the developed countries, but easily found in developing countries. However, the rest of the factors are still important to implement e-tendering or e-procurement whether in developing or developed countries.

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