

The Indicators Determination of Contractors in the Procurement Process of Road and Bridge Construction Projects

[Latupeirissa Josefina Ernestine ¹, Irwan Lie Keng Wong ²]

Abstract— Procurement of goods and services aims, among others, to produce goods and services that are appropriate for every money spent, measured in terms of quality, quantity, time, cost, location and provision. The success of the procurement of goods and services in the supply chain vertical structure will have an impact on the procurement of services in a horizontal structure, namely the determination of service providers or contractors. Based on this, a study was carried out aimed at analyzing the Indicators of Determination of Contractors in the Procurement Process of Road and Bridge Construction Projects. Determination of the contractor as the winner of the tender was carried out by the organization of the vertical supply chain pattern procurement of road and bridge construction projects. Data collection was conducted in three provinces in the eastern part of Indonesia in the form of primary data, namely direct observation and filling in questionnaires and interviews with 30 respondents. Test the hypothesis about the proportion of the population compared to the t distribution . where the result is the probability t count is smaller than the probability t distribution ($t \leq t_{1-\alpha}$) which means that all respondents' answers are accepted. This states that the contractor must meet the indicators set by the government if wish to succeed in the process of procuring road and bridge construction projects.

Keywords— Contractor Determination Indicators, procurement of road and bridge projects, Eastern Indonesia

I. Introduction

The construction of road and bridge construction aims to connect an area to another area so that it can mobilize people and goods. With the existence of remote and isolated areas, especially in the eastern part of Indonesia, the Indonesian government has continuously carried out the construction of road and bridge infrastructure to reduce and even eliminate these disparities.

Latupeirissa Josefina Ernestine
Universitas Kristen Indonesia Paulus
Makassar- South Sulawesi - Indonesia

Irwan Lie K W
Universitas Kristen Indonesia Paulus
Makassar- South Sulawesi - Indonesia

The process of procuring road and bridge transportation facilities in Indonesia is based on the Republic of Indonesia Presidential Regulation Number 16, 2018 concerning Procurement of Government Services. Procurement of goods and services aims, among other things, to produce goods and services that are suitable for each money spent, measured in terms of quality, quantity, time, cost, location, and provision. The party responsible for the procurement process is an organization in the vertical structure of the supply chain pattern, namely the Service User or Owner. The success of the procurement of goods and services in the vertical structure of the supply chain will have an impact on the procurement of services in a horizontal structure, namely the determination of service providers or contractors.

The selection of a proper construction contractor increases chances of successful completion of a construction project (Alhazmi and McCaffer, 2000). It can also fulfill the client goals, and keep the schedule of the cost, time and quality. Based on this, a study was carried out aimed at analyzing the Indicators of Determination of Contractors in the Procurement Process of Road and Bridge Construction Projects. Determination of the contractor as the winner of the tender was carried out by the organization of the vertical supply chain pattern procurement of road and bridge construction projects.

II. Procurement of Road and Bridge Projects

The construction and upgrading of roads and bridges as one of the infrastructure, especially in Eastern Indonesia, is a government priority such as the development of connectivity in an effort to develop the masterplan to expand Indonesia's Economic Development Acceleration stipulated by the government in the Republican Presidential Regulation.

A. Construction Procurement

The Construction procurement is a complex process with a large number of available options and directions (Ruparathna, and Hewage, 2014). The definition of procurement in general terms refers to the acquisition of goods, services, or construction, from a third party, at the best possible price, in an appropriate quantity, at the right time and place (Martins 2009). A traditional perception of procurement was that it should be a separate contract with an arm's length relationship between contractors and a client (Cox and

Townsend 1998). In general, the procurement process is organized as per the owner's discretion. The project owner, representative, or an external party assumes the responsibility of managing the procurement process (**Cox et al. 2006**).

Tendering is the process of selecting the most suitable contractor for a construction project. The tendering process involves two distinct mutually exclusive activities. The first activity, according to involves the preparation of tender estimates by contractors for the purpose of submitting a bid. The second activity deals with the evaluation of the bids submitted by contractors to enable the best contractor(s) to be selected and is normally carried out by owners and/or their professional advisors such as quantity surveyors and project managers (**Moselhi & Martinelli (1990)** being documented by **Oladapo and Odeyinka(2006)**. The tender evaluation method used is critical to the success of the project because it strongly affects the subsequent outcome of the project (**Jaselskis and Russell, 1992** being documented by **Oladapo and Odeyinka(2006)**).

The aim of the public procurement rules is to ensure that contracting authorities use public funds to finance public purchases in the best possible way by seeking out and taking advantage of competition in the relevant market to get a good deal. Simultaneously, the rules and regulations aim to afford suppliers the opportunity to compete on equal terms. Therefore, procurements within public agencies must normally go through a tendering process, and the concept of the lowest bid is normally used (**Safi et al, 2014**).

B. Procurement Based on Presidential Regulations

A primary issue that is often raised within the construction industry relates to what clients want in order to be satisfied with their buildings and the means by which those buildings have been procured. Consequently, it is important to evaluate the clients' criteria, their importance and then seek performance to match the criteria. While the use of such criteria can be used as a guide to assist decision-makers with an initial understanding of the basic attributes of a particular procurement system they should not be used as a basis for selecting the procurement method. This is because of the underlying complexity associated with matching client needs and priorities with a particular method (**Kumaraswamy and Dissanayaka, 1998**) being documented by **Baccarini et al (2008)**.

Procurement of Government Goods and Services has an important role in the implementation of national development to improve public services and the development of national and regional economies.

In order to realize Government Goods and Services Procurement, it is necessary to regulate the Procurement of Goods and Services that provide the maximum value of

benefits and contribute to the increased use of domestic products, increase the role of Micro, Small Business and Medium Enterprises as well as sustainable development (**Republic of Indonesia presidential regulation Number 16, 2018**).

According to **Latupeirissa and Wong (2018)**, the occurrence of irregularities in the supply chain from the process of procuring road and bridge projects raises risks in the implementation of the project. Therefore the determination of the winner of the tender must meet the Indicators which include: Qualification Requirements for Business Entity Administration, Business Entity Technical Qualification Terms, Business Entity Financial Qualification Terms, Bid Technical Evaluation, Bid Price Evaluation. (**Regulation of the Minister of Public Works and Housing, No.7, 2019**)

III. Research Method

Highly competitive and profound changes in the construction industry are forcing construction executives to continuously improve the performance of their firms (**Hany et al, 2013**). Performance measurement is the heart of cease- less improvement. As a general rule, benchmarking is the next step to improve contractors efficiency and effectiveness of products and processes (**Luu et al, 2008** being documented by **Elshakour et al, 2013**).

The contractor as the winner of the tender must meet the qualifications based on the indicators set by the Indonesian government. Therefore to measure contractor's knowledge of these indicators, data is collected from the project manager, which consists of project owners, consultants and contractors.

A. Data Collection

Data is collected directly from the object under study and comes from the actual situation including direct observation in the field. While interviews were conducted with related parties in the procurement of road and bridge projects in Eastern Indonesia. The purpose of the interview is to verify data obtained from observations and information from existing data.

Respondents interviewed were representatives of owners, large contracting companies that met the requirements and consulting companies, all of which were 30 respondents

Indicators which include: Qualification Requirements for Business Entity Administration, Provisions on Business Entity Technical Qualifications, Business Entity Financial Qualification Requirements, Bid Technical Evaluation, Bid Price Evaluation shown in Table I.

TABLE I. INDICATORS OF DETERMINATION OF CONTRACTORS

No	Code	Indicator
I		
Qualification requirements for business entity administration (QRfBEA)		
1.	I.1	Having a construction services business license for foreign consultancy services business entities, have proof of permit for representatives of foreign consultancy services
2.	I.2	Have a business entity certificate with qualifications and classifications/subclassifications that meet the requirements
3.	I.3	Has a quality management certificate, occupational health and safety management certificate and environmental management certificate for employment complex construction and or for large qualified business actor
4.	I.4	Has a taxpayer identification number and has fulfilled the obligation taxation
5.	I.5	Having deed of establishment of the company and its amendments
II		
Terms of technical qualification of business agency (ToTQoBA)		
1.	II.1	Experience at least 1 (one) job inside the last 4 (four) years, including subcontracting experience except for the provider just established less than 3 (three) years
2.	II.2	Have basic ability for work intended for medium and large businesses with a basic ability score equal to 3 experience score highest in sub-classification, type of work, and / or key activities (major items) that are in accordance with the requirements in the last 10 years
3.	II.3	Meet the remaining package capabilities for small businesses
4.	II.4	Have at least a. 1 (one) certified permanent staff that is in accordance with the classification of Business Entity Certificates required for small businesses b. 1 (one) permanent certified staff that is in accordance with the sub-classification of business entity certificates required for medium and large businesses and selected according to the required qualifications
III		
Business Entity Financial Qualification Requirements (BEFQR)		
1.	III.1	Have Real Remaining Capabilities with numbers at least equal to 10% (ten percent) from estimated own prices, which are accompanied by financial statements for work aimed at medium and large companies. Especially for large businesses, financial statements must be audited
IV		
Bid Technical Evaluation (BTE)		
1.	IV.1	The elements assessed and procedures for evaluating: Job Implementation Method; Duration of implementation work; Having the ability to provide personnel; Have the ability to provide main equipment; Subcontracting partially work that is not a job main; Delivering Identification fields danger.
	IV.2	The methods offered by participants are compared to the methods that have been set
V		
Bid Price Evaluation (BPE)		
	V.1	OHS and Construction Safety implementation costs must be calculated separately in the total cost of the offer, with the amount of the cost according to the needs

B. Indicator Measurement

The mean of this observation, called the population or sample is calculated as follows (Johnson and Bhattacharyya, 1992)

$$\mu = \bar{x} = \frac{\text{sum of the observations}}{\text{sample size}} \quad (1)$$

The mean of X or population mean

$$\begin{aligned} E(X) &= \mu \\ &= \sum (\text{value} * \text{probability}) \\ &= \sum x_i f(x_i) \end{aligned}$$

Here the sum extends over all the distinct values x_i of X

The variance of X is abbreviated as Var(X), and is also denoted by σ^2 . The standard deviation of X is positive square root of the variance, and is denoted by sd(X) or σ .

Variance and standard deviation of X :

$$\begin{aligned} \sigma^2 &= \text{Var}(X) = \sum (x_i - \mu)^2 f(x_i) \\ \sigma &= \text{sd}(X) = +\sqrt{\text{Var}(X)} \end{aligned} \quad (2)$$

C. Testing hypotheses about a population proportion

Testing using formulas :

$$t \text{ calculate} = \frac{\bar{x} - \mu_0}{\frac{s}{\sqrt{n}}} \quad (3)$$

where :

μ_0 = score determined by the researcher

t = price on distribution list

Siq = $\alpha = 0,05$, then the testing criteria are

H_0 retain if $t \leq t_{1-\alpha}$

$t_{1-\alpha}$, is obtained of t distribution list with opportunities $1-\alpha$

Either reject H_0

degree of freedom (df) = n - 1

IV. Results And Discussion

The parties representing the owner, consultant, and contractor, are 30 respondent were asked to answer questions on 13 indicators as a determination that the contractor was successful

in the procurement process. Respondents answers for first indicators is shown in Table II.

TABLE II. RESPONDENTS ANSWERS FOR FIRST INDICATORS (I.1)

(Having a construction services business license for foreign consultancy services business entities, have proof of permit for representatives of foreign consultancy services)

No	Respondents	The contractor was successful in the procurement process (%)
1.	R1	85
2.	R2	90
3.	R3	85
4.	R4	95
5.	R5	95
6.	R6	87
7.	R7	88
8.	R8	98
9.	R9	95
10.	R10	95
11.	R11	85
12.	R12	89
13.	R13	88
14.	R14	90
15.	R15	95
16.	R16	94
17.	R17	91
18.	R18	95
19.	R19	99
20.	R20	89
21.	R21	90
22.	R22	85
23.	R23	80
24.	R24	90
25.	R25	95
26.	R26	90
27.	R27	90
28.	R28	97
29.	R29	89
30.	R30	90
	Sum	2724

The average value of respondents' answers based on formula (1) is

$$\bar{X} = \frac{2724}{30} = 90.80$$

In the same way, the respondent's answers to other indicators are analyzed and the average calculation. The results are shown in Table III.

The initial hypothesis (H0) states that the contractor can succeed in the procurement of road and bridge construction projects if it meets the required indicators which means H0 is retain. By using formula (3), the results of the calculations compared with the distribution t, are shown in Table IV

TABLE III. THE NUMBER OF RESPONDENTS' ANSWERS AND THE AVERAGE

No	Code	Σ	μ = \bar{X}
I			
1.	I.1	2724	90,80
2.	I.2	2729	90,97
3.	I.3	2727	90,90
4.	I.4	2724	90,80
5.	I.5	2728	90,93
II			
1.	II.1	2729	90,97
2.	II.2	2730	91,00
3.	II.3	2727	90,90
4.	II.4	2724	90,80
III			
1.	III.1	2730	91,00
IV			
1.	IV.1	2728	90,93
	IV.2	2724	90,80
V			
	V.1	2730	91,00

Formulation (3)

$$t_{\text{calculate}} = \frac{\bar{X} - \mu_0}{\frac{s}{\sqrt{n}}} = \frac{90,8 - 90}{\frac{4,42}{\sqrt{30}}} = 0,9950$$

TABLE IV. COMPARISON OF THE VALUE OF T CALCULATION WITH THE VALUE OF T DISTRIBUTIONS

No	Code	\bar{X}	σ	μ0	t calculate	t _{0,9529} Table
I QRfBEA						
1.	I.1	90.80	4.420	90	0,99	1,70 Ho retain
2.	I.2	90.87	4.440	90	1.20	1,70 Ho retain
3.	I.3	90.90	4.430	90	1.12	1,70 Ho retain
4.	I.4	90.80	4.420	90	0.99	1,70 Ho retain
5.	I.5	90.93	4.437	90	1.15	1,70 Ho retain
II ToTQoB A						
1.	II.1	90.97	4.440	90	1.20	1,70 Ho retain
2.	II.2	91.00	4.445	90	1.24	1,70 Ho retain
3.	II.3	90.90	4.430	90	1.12	1,70 Ho retain
4.	II.4	90.80	4.420	90	0.99	1,70 Ho retain
III BEFQR						
1.	III.1	91.00	4.445	90	1.24	1,70 Ho retain
IV BTE						
1.	IV.1	90.93	4.437	90	1.15	1,70 Ho retain
	IV.2	90.80	4.420	90	0.99	1,70 Ho retain
V BPE						
	V.1	91.00	4.445	90	1.24	1,70 Ho retain

The calculation results shown in Table IV indicate that indicators **Qualification requirements for business entity administration** , **Terms of technical qualification of business agency** , **Business Entity Financial Qualification Requirements** , **Bid Technical Evaluation** and **Bid Price Evaluation** show the probability of t that is smaller than the probability of t distribution ($t \leq t_{1-\alpha}$) which means that H_0 is retain.

v. Conclusion

The results of the analysis show that the respondent's answer states that the contractor must meet the indicators required by Republic of Indonesia presidential regulation Number 16, 2018 if wish to succeed in the process of procuring road and bridge construction projects

Acknowledgment

Thank you to the Ministry of Research, Technology and Higher Education through the Directorate General of Higher Education which has funded this research through the PTUPT Grant in 2019

References

- [1] T. Alhazmi, T. and R. McCaffer, "Project procurement system selection model", *Journal of Construction Engineering and Management*, 126, 176–184. 2000
- [2] R. Ruparathna, and K. Hewage, "Review of Contemporary Construction Procurement Practices. *J. Manage. Eng.* DOI: 10.1061/(ASCE)ME.1943-5479.0000279. 2015
- [3] M. Martins, "Procurement." *Encyclopedia of business in today's world*, C. Wankel, ed., SAGE Publications, Thousand Oaks, CA, 1309–1311. 2009
- [4] A. Cox, , P. Ireland, , and M. Townsend, "Managing in construction supply chains and markets: Reactive and proactive options for improving performance and relationship management", Thomas Telford Publishing, London. (2006)
- [5] A. Cox, and M. Townsend, "Strategic procurement in construction: Towards better practice in the management of construction supply chains", Thomas Telford Publishing, Lincolnshire, U.K. (1998).
- [6] A. Oladapo & H. A Odeyinka "Tender evaluation methods in construction projects: a comparative case study". *Acta Structilia* 2006
- [7] M. Safi, H. Sundquist, and R. Karoumi, " Cost-Efficient Procurement of Bridge Infrastructures by Incorporating Life-Cycle Cost Analysis with Bridge Management Systems" *J. Bridge Eng.* 2015.20.
- [8] P. Love, P. Davis, D. Baccarini, G. Wilson and R. Lopez "Procurement selection in the public sector: a tale of two states". *Clients Driving Innovation: Benefiting from Innovation* Third International Conference of the Cooperative Research Centre (CRC) for *Construction Innovation* (12-14 March 2008)
- [9] Republic of Indonesia Presidential Regulation Number 16/2018 : Government Goods / Services Procurement 2018
- [10] J. E. Latupeirissa and I. L. K. Wong, "Risk Due to Deviations General Pattern of Supply Chain the Procurement Process of Road and Bridge Projects", 17th International Conference on Contemporary, Engineering and Management (ICCI-SEM). IIRAJ. On 16-17 February, 2019
- [11] Regulation of the Minister of Public Works and Housing, No.7, 2019 "standards and guidelines for the procurement of construction services through providers" 2019
- [12] H. A. Elshakour, M. A. Ibrahim, A. Al-Sulaihi and, K. S. Al-Gahtani, "Indicators for measuring performance of building construction companies in Kingdom of Saudi Arabia" *Civil Engineering Department, College of Engineering, King Saud University, Saudi Arabia* 12 April 2012. Elsevier B.V. reserved. <http://dx.doi.org/10.1016/j.jksues.2012.03.002>
- [13] R. A. Johnson and G. K. Bhattacharyya, *Statistics, Principles and Methods*. Second Edition. By John Wiley & Sons. Inc. 1992