Analysis of Factors affecting Construction Project Tender Winning in Small Qualification Contractors

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ABSTRACT

Finding employment in the construction sector almost always involves a tender process, which is essential for the construction entrepreneurs because the company's continuity depends on it. Tender qualifications and requirements must fulfill several stages, namely the administrative, qualification, technical, and price evaluation. The purpose of this research is to predict the relationship between certain variables. The Partial Least Square (PLS) method is deployed since it can directly analyze the latent variables, indicator variables, and measurement errors and determine the complexity of the relationship between several variables and their indicators. Eight main factors were successfully obtained: Regulations, Company Qualifications, Administration, Equipment Resources, Human Resources, Construction Safety Plan, Financial, and Technology and Information Systems. Using the SEM-PLS also resulted in estimating the significance value of the factors influencing the highest tender winner determinants: Human Resources obtained a value of 84.5% and the Financial variable attained a value of 82.3%. This research is expected to assist contractors in getting acquainted with the level of significance of the tender winners' determinants for the construction projects. Contractors can also prepare and improve the Human Resources factor by conducting advanced training, certification, and competency development that supports its technical capabilities. Contractors need to obtain a deep understanding of the tender requirements, and with a high experience level they can make more appropriate and competitive offers.

Keywords-small qualification; tender; contractor; partial least squares

I. INTRODUCTION

The construction sector significantly contributes to a nation's economic growth by providing employment opportunities for the unskilled, semi-skilled, and skilled labor. It experiences direct and indirect influences through intricate interconnections within its system [1]. The construction industry in Indonesia is experiencing an annual growth rate of 6%-7%, with projections indicating an anticipated expansion to 10%-15% by 2050, which aligns with the objectives outlined in the Masterplan for the Acceleration and Expansion of Indonesia's Economic Growth (MP3EI) program [2]. Project work is typically obtained through auctions or tenders in the construction service sector. This process is essential for the construction service entrepreneurs because their survival depends on its success [3]. Government construction project budgets are funded by the state budget, requiring strict adherence to the rules and procedures set by the government. As a result, the tendering processes are subject to more limited rules and procurement systems [4]. The project owner assesses the quality of services not only from a technical aspect, but also from a functional one. The quality of contractor services has a close relationship with the satisfaction of the project owner, which provides an impetus to establish a relationship with the contracting company [5]. The elements influencing contractors include tangibility, which covers the physical aspects, such as equipment, workforce, and communication tools. Reliability refers to the ability to deliver services promptly, efficiently,

accurately, and satisfactorily. Responsiveness involves providing high-quality and timely customer service. Assurance includes knowledge, expertise, politeness, and trustworthiness. Empathy involves building relationships easily, communicating effectively, providing attentive care, and understanding customer needs [6].

The construction project life cycle consists of four phases: feasibility study, project estimation (detailed estimate design), construction process, and operation and maintenance. Each phase generates distinct deliverables, with the detailed estimate design process producing the bidding document as one of its key outputs [7]. Executing a construction project entails the collaborative efforts and coordination of diverse entities, including architects, contractors, labor, and material service providers. Project owners typically choose a capable contractor to oversee the project to achieve the desired construction outcome. Participating in auction offers or project tenders is commonly used to secure a construction project [8]. In construction services, auctions are organized by the assigning party or project owner, wherein multiple construction service companies or contractors are invited. The objective is to select a single winner capable of executing and completing the project or task by specified requirements, ensuring a reasonable cost, and demonstrating accountability regarding time, quality, and efficiency [9]. Tendering refers to requesting suppliers or contractors to submit proposals for the supply, execution, and procurement of a specific project. Similarly, tendering involves assembling multiple contractors or suppliers within the construction contracting market for the same project [10]. The effectiveness of a tender process hinges on factors, such as the financial soundness of the contractor, the proposed pricing and projected delivery schedule, the contractor's track record, environmental factors, the technology employed, and the qualifications of the personnel involved [11]. As a result, the tender process selects contractors to achieve a certain quality standard without wasting money. The factors described will later become a benchmark for improving contractor performance [12]. Project performance refers to how the project work process is carried out by comparing the achievement of realization against the work target according to the contract between the project owner and the implementer [13]. The outcome of an experience that is measurable based on this type of agreement is a guide to the desired achievement. In addition, to provide an assessment of success, indicators derived from the activities carried out are needed [14]. Enhancing contractor performance is significantly influenced by the experience of the workforce. Labor experience entails accumulating knowledge and skills regarding the job methods followed through an active engagement in job responsibilities. An individual's labor experience illustrates the range of tasks they have undertaken, offering a valuable opportunity for improved job performance [15].

II. METHODOLOGY

A. Design

This study employs descriptive and quantitative research methods to align with the research variables that concentrate on real-world issues and current phenomena. The research outcomes are presented in a numerical form, providing meaningful insights. Descriptive research methods along with a quantitative approach are specifically utilized when the goal is to describe or elucidate events or incidents that are currently occurring, utilizing meaningful numerical representations.

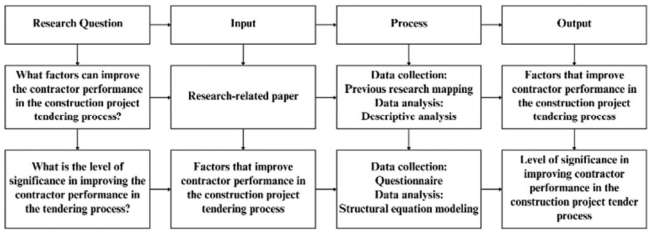

Fig. 1. Operational framework.

B. Data Collection and Analysis

The research collected both primary and secondary data. The primary data consisted of mapping previous research and analyzing the results of questionnaires distributed to selected contractors in Indonesia. The purpose of mapping previous research was to identify factors influencing the contractor tender success, which were then modified to suit the context of the construction projects in Indonesia. These modifications considered the specific differences in the tender regulations and requirements within the country. The secondary data, on the other hand, refer to supporting the data derived from historical reports, such as archives or published/unpublished documents. The secondary data in this research include information from relevant journals, previous research, and activity reports. The population in this study is all contractor companies having been registered in the e-procurement system in Indonesia for the last five years. Contracting companies include small-scale businesses. The sample size in this study was determined using the Slovin formula approach to ensure the representation of a large population. With an estimated population of 500 contractor companies actively participating in tenders in Indonesia, the sample size was calculated using a margin of error of 5%. From the calculation results, the sample used amounted to approximately 223 contractors. Each stratum is selected by reviewing the classification of the qualification levels regulated by the government considering the number of projects handled and their value. This method aims to obtain a fair representation of the various groups of contractors relevant to the context of this study. The research questionnaire, using a 5-point Likert scale, was designed to assess the factors influencing the tender winner selection. It included 30 questions divided into four sections: company qualifications, financial strength, technology, and human resources. The questionnaire was distributed online to eligible contractors, with data having been collected over three months. Out of the 223 questionnaires sent, 200 were returned, achieving a 90% response rate. This research combines descriptive and quantitative research methods to address the research variables focused on real-world issues and current phenomena. The research findings are expressed numerically, offering meaningful insights. Descriptive research methods along with a quantitative approach are specifically applied when the objective is to depict or clarify ongoing events or incidents using significant numerical representations. The research

methodology in this study employs the PLS as an alternative estimation technique for Structural Equation Modeling (SEM). SEM is a multivariate statistical analysis method that combines factor analysis, structural modeling, and path analysis. Unlike the traditional regression or path analysis methods, PLS does not require normality assumptions and can work effectively with small sample sizes. It uses bootstrapping or random sampling techniques to estimate the model parameters. The secondary data for this study were gathered from relevant journals, previous research, and activity reports. The data analysis process involved using statistical methods to address the research questions, with PLS providing a practical solution when normality assumptions were not met, or sample sizes were limited. This approach demonstrates the versatility of PLS as a robust tool in situations where traditional SEM methods may not be applicable.

III. RESULTS AND DISCUSSION

A. Research Variables

Literature review was conducted to examine the factors that determine the winner of contractor tenders on the construction projects. The regulations, qualifications, experience, and bid price were key factors in this analysis. The results showed a significant relationship between the regulations governing the tendering process and the success of the contractors in winning tenders. SEM allows for a more detailed investigation of the complex relationships between these variables and provides a deeper understanding of the importance of certain factors in influencing a contractor's decision to win a tender for a construction project. Table I outlines the variables involved in determining the factors for winning contractor tenders on construction projects. These variables were obtained from a literature review of several related papers indexed by Scopus. After collecting these papers, a mapping process was conducted to identify the influential factors.

TABLE I. DEPENDENT AND INDEPENDENT VARIABLES

Variables	Code	Indicators	Ref.
(X.1) Regulations	X.1.1	Understanding of legal rules and regulations	[16]
	X.1.2	Compliance with construction service procurement rules	[17]
(X.2) Company qualification	X.2.1	Ability to complete the legality of the business entity (Establishment/adoption deed management)	[18]
	X.2.2	Ability to complete business licenses in the field of construction services	[18]
	X.2.3	Ability to complete business entity certificate	[19]
	X.2.4	Company experience in construction within the last 4 years	[20]
	X.2.5	Total work being carried out (for calculation)	[21]
	X.2.6	Possession of a quality management certificate, environmental management certificate, and occupational safety and health certificate.	[21]
	X.2.7	Possession of a taxpayer identification number with a taxpayer identification status based on the results of confirmation of valid taxpayer status.	[22]
	X.2.8	Length of time working in the construction sector	[22]
	X.2.9	Frequency of failure to complete contracts on time/contractor reputation	[23]
(X.3) Administration	X.3.1	Validity and completeness of the offer letter	[24]
	X.3.2	Ability to provide bid security	[24]
	X.3.3	Appropriateness of planned timeframe for completion of work	[25]
(X.4) Equipment resources	X.4.1	Understanding of equipment requirements	[18]
	X.4.2	Ability to offer minimum equipment type, capacity, composition, and quantity	[20]
	X.4.3	Ability to provide proof of ownership/proof of support for equipment	[21]
(X.5) Human resources	X.5.1	Understanding of managerial personnel requirements	[22]
	X.5.2	Ability to fulfill the requirements of certificate of work competency and certificate of personnel	[26]
	X.5.3	Ability to offer managerial personnel competencies including length of work experience	[20]
	X.5.4	Ability to offer managerial personnel who are not currently working on other/ongoing work packages	[22]
(X.6) Constructions safety plan	X.6.1	Ability to complete elements	[26]
	X.6.2	Ability to complete the commitment pact signed by the highest management of the service provider company.	[28]
(X.7) Financial	X.7.1	Knowledge of base price	
	X.7.2	Ability to make unit price analysis	[26]
	X.7.3	Ability to prepare quantity and pricelist	
	X.7.4	Ability to bid responsive and competitive prices	[29]
	X.7.5	Ability to fulfill capital requirements (bid guarantee, administrative costs, equipment and personnel)	[30]
(X.8) Technology and information systems	X.8.1	Understanding and mastery of procurement implementation technology	[31]
(Y) Determinants of contractor tender winner	Y.1	Projects won by contractors in the tender process in Indonesia	[28], [32]

B. Discriminant Validity Measurement

Table II shows that several indicators meet the 7% significance value requirement and have a loading factor greater than 0.7. Therefore, the construct is considered valid, as it satisfies the validity criteria with a loading factor exceeding 0.7.

The next step is to evaluate the convergent validity using the Average Variance Extracted (AVE) value. A model is

considered to have high convergent validity if the AVE value exceeds 0.6. After removing the loading factors below 0.6, the model's AVE value is calculated. Table III demonstrates that the composite reliability values for all constructs are > 0.8, which indicates that all constructs in the estimation model have high reliability and meet the reliability criteria. The reliability test can also be strengthened with the Cronbach's alpha, whose value is good if ≥ 0.5 and sufficient if α ≥ 0.3. Table II depicts the Cronbach's alpha output of the used SmartPLS 3.0 software. Based on Table III, the Cronbach's alpha value is ≥ 0.6, which means that all variables have a good reliability.

TABLE II. AVE VALUE

Variable	AVE
X1 (Regulations)	0.782
X2 (Company qualification)	0.635
X3 (Administration)	0.894
X4 (Equipment resources)	0.789
X5 (Human resources)	0.745
X6 Constructions safety plan	0.868
X7 Financial	0.788
X8 Technology and information systems	0.868

TABLE III. CRONBACH'S ALPHA VALUE

Variable	Cronbach's Alpha
X1 (Regulations)	0.752
X2 (Company qualification)	0.928
X3 (Administration)	0.941
X4 (Equipment resources)	0.938
X5 (Human resources)	0.888
X6 Constructions safety plan	0.849
X7 Financial	0.935
X8 Technology and information systems	0.932

C. Convergent Validity Measurement

The convergent validity proves that the respondents can understand the statements on each variable in this study on the basis of the researcher's understanding. The individual indicators are considered reliable with a correlation value or loading factor≥0.5. The data analysis results for the convergent validity measurement are illustrated in Table IV. The fit model of a variable analyzed with PLS is required to meet the convergent validity value, namely an indicator with a factor loading above 0.5. So, an indicator with a factor loading below 0.5 is declared invalid as a construct of the empowerment variable and must be again eliminated (dropped) from the analysis. Table IV exhibits that all indicators meet the requirements of the convergent validity test, namely ≥ 0.5, which means that all indicators used in this study are valid.

D. Inner Model Measurement

The inner or basic model tries to see the relationship between the builds, the note worth in esteem, and the R-square of the investigation. Auxiliary models were assessed utilizing the R-square for the t-test-dependent bodies and the centrality of the additional way parameter coefficients.

Assessing the model with PLS begins by looking at the R-square for each latent dependent variable. The coefficient of assurance (R-square) could be a way to survey how much an exogenous build can clarify an endogenous construct. The expected value of the coefficient of determination is between 0 and 1. The following is the result of the R-square estimation using SmartPLS.

TABLE IV. CONVERGENT VALIDITY

Variable	Cross loading
X.1.1	0.960
X.1.2	0.801
X.2.1	0.815
X.2.2	0.839
X.2.3	0.760
X.2.4	0.852
X.2.5	0.766
X.2.6	0.811
X.2.7	0.759
X.2.8	0.783
X.2.9	0.781
X.3.1	0.956
X.3.2	0.939
X.3.3	0.941
X.4.1	0.929
X.4.2	0.949
X.4.3	0.951
X.5.1	0.929
X.5.2	0.892
X.5.3	0.798
X.5.4	0.828
X.6.1	0.919
X.6.2	0.944
X.7.1	0.889
X.7.2	0.923
X.7.3	0.936
X.7.4	0.838
X.7.5	0.849
X.8.1	1.000
Y	1.000

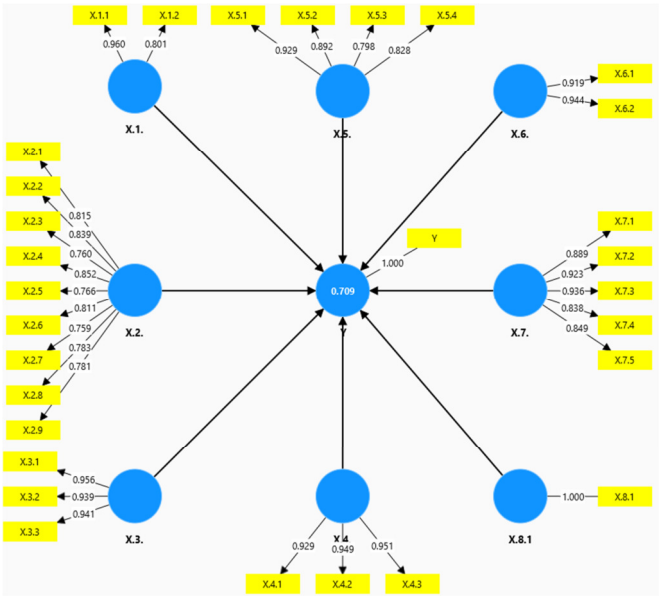

Fig. 2. Inner model measurement.

TABLE V. R-SQUARE

Y	R-square value
Winning Factors Tender	0.709

Table V demonstrates that the R-squared value for the Green Construction Implementation Constraints data is 0.709, or 70.9%. This indicates that the research model falls within the substantial model specification range of 50%-75%, suggesting that it is a good fit.

E. Hypothesis Testing

The hypothesis testing is conducted to determine whether the exogenous factors influence the endogenous factors. The test criteria require that $T_{statistics}$ be greater than or equal to the T_{table} value of 1.96. In this case, the exogenous factors positively and significantly influence the endogenous factors. The results of the significance test are presented in Table VI.

TABLE VI. MODEL CALCULATION

Hypothesis	T-statistics	P-value	Results
X1 -> Y1	3.434	0.021	Accepted
X2 -> Y1	3.990	0.000	Accepted
X3 -> Y1	2.100	0.002	Accepted
X4 -> Y1	2.576	0.048	Accepted
X5 -> Y1	2.246	0.003	Accepted
X6 -> Y1	4.290	0.026	Accepted
X7 -> Y1	2.174	0.008	Accepted
X8 -> Y1	1.722	0.032	Accepted

The Regulatory variable, with a high percentage of 84.5%, demonstrates that Human Resources significantly influence the factors determining the contractor tender success in Indonesia, obtaining a value of 62.5%. Similarly, the Financial variable, with a value of 82.3%, shows that the company qualifications strongly impact these factors. The Administration variable, with a value of 77.1%, confirms that the Administrative factors play a significant role in determining the contractor tender outcomes in Indonesia. The Construction Safety Plan and Equipment Resources variables also contribute significantly, with impact values of 73.3% and 69.7%, respectively. Company Qualifications' influence value is 67.9%, while Technology and Information Systems account for a value of 62.2% and Regulations have an impact value of 58.3%. Although these variables vary in strength, they all significantly influence the factors that determine the contractor tender success in Indonesia.

IV. CONCLUSION

The present work reviewed previous papers to delineate the factors that influence the determinants of winning tenders, resulting in eight main factors: Regulations, Company Qualification, Administration, Equipment Resources, Human Resources, Construction Safety Plan, Financial, and Technology and Information System. The SEM-PLS analysis results demonstrated that the R-Square for the Contractor Performance data in the Small Qualification Contractor Tender Winning is 0.709 or 70.9%. The developed research model is included in the robust model specification because it is in the range of 50%-75% and can be thus considered a good fit. The significance values of the factors affecting the tender winner determinants based on the obtained data were: Human Resources Qualification 84.5%, Financial 82.3%, Administration 77.1%, Construction Safety Plan 73.3%, Equipment Resources 69.7%, Company Qualifications 67.9%, Technology and Information Systems 62.2%, and Regulations 58.3%.

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