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Bidding Strategy Using Friedman Model for Building Construction Project in Banjarbaru Indonesia

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Abstract: Determining a good price in competitive bidding is a common problem for the construction company. An offer price could be too high for contractors hoping to get a big profit with no risk to get the project, or too low in the hope of getting a lot of projects but at the risk of losing opportunity to get benefits and risks of failure in carrying out the work.Friedman model was selected for bidding strategy purpose. The model was applied to a number of data offering price of contractors bidding for the construction of buildings in the city Banjarbaru starting in 2012-2015, which has Owners's estimate with a range between IDR 248 million to IDR 4.8 billion. Then the test data results with the data that has been set aside for testing the model.Friedman bidding strategy models produced Mark-Up valued at -9% for multi normal distributions and -5% for a single normal distribution. Mark-Up is validated on the winning bidder of IDR 478,590.00. The tests produced the offering price of IDR 478,560,210.00 (with Mark Up -8.84%) and IDR 498,726,250.00 (with Mark Up -5%). So Friedman models with Multi Normal Distribution can beat the lowest bid.

Keywords: Procurement, Bidding Strategy, Normal Distribution, Friedman, Mark Up

1. Introduction

The common problem of the contractor in procurement process is the bidding price too high for getting big profit, otherwise with low price for getting greater opportunities of the winning project. These two opposite conditions take place in the same time, so it will be very difficult for the contractor to determine the bid price. In the project tender offer, everything has to be obvious and rational, so this is very important in determining the right bidding strategy.

Thus the model of bidding strategy required by the contractor so that it can win the project and a profit of liking contractor. There are various models of bidding strategy in construction projects including Model Gates, Ackoff & Seasieni Model, and Model Friedman (Patmadjaja, 1999).

By observing the results of the calculation of the optimum Mark Up of the journal "model of construction project bidding strategy" three models, that Friedman model Mark-Up optimum yield of 8.5%, lower than model Ackoff & Seasieni and Gates that produces optimum Mark-Up by 9%. If the contractor is in desperate need of work as well as competitors who are also in need of work, and equally master the theory model of bidding strategy, then you should use a model that generates Friedman Mark Up smaller. (Ferry, Sholeh)

Tender bid decision-making is an activity that the bidders do a series of calculations, assessment and analysis to bid project, then determine the compliance costs, formulate suitable bidding strategy for projects according to the evaluation principles of tender documents, to ensure profit maximization protection under the premise of winning bid (Manns & Haimus, 2000). Right bid strategies and techniques is critical to project quotation, directly influence the success of a project, the existing bid decision-making model includes: bid decision-making model based on game theory (Pei and Jian, 2011), bid decision-making model based on probability theory (Friedman, 1956), bid decision-making model based on Analytic Hierarchy Process and utility theory (Yong, Zhi, Mi, and Su, 2006), bid decision-making model based on fuzzy mathematics research (Guo, Wei and Jin, 2012), bid decision-making model based on artificial intelligence (Hong and Yi, 2010). Contractors realize that bidding low when facing strong competition

increases the chance of being chosen to perform the work but they are also aware of the opposite: if the price included in their proposal is higher, the likelihood of winning the bid will definitively be lower. This inverse relationship between the level of the profit margin (commonly known in the construction management literature as the “mark-up bid”) and the probability of getting the contract is an accepted fact both in the construction industry and within the research community (see, for example, Christodoulou (2010); Kim and Reinschmidt (2006); Tenah and Coulter (1999); Wallwork (1999). A lot of research on the existing tender offer model at home and abroad, proposes a new tender offer model called Friedman model combined with the tender offer market environment of State Grid Corporation Power Transmission Project. Then studies the feasibility in bidding offer of State Grid Corporation Power Transmission Project, and demonstrates the guiding role of this bid model to tender offer through a case, which has a certain reference value. Friedman model were proposed which is suitable for the tender offer of this project. An engineering case was applied to prove the validity and practicality of this model (Yang X. and Xue H, 2013).

A lot of work has been done toanalyze the probability value and profit expectations based on the Mark-Up of the data set offers in Banjarbaru in 2012 to 2015 and to analyze whether the Friedman model can be applied in city of Banjarbaru local government project in determining the offer price in the auction that has the possibility of winning projects and also getting sufficient benefit.

2. Procurement Feature of Banjarbaru City Council Project

A construction project is a series of activities carried out only one time and is generally short-term. According Suharto (1997), the project activity is one activity while lasting for a limited period, with a specific allocation of resources and is intended to carry out tasks that targets have been outlined clearly. In addition, construction projects also have characteristics that are unique, requiring resources (manpower, materials, machines, money, method), as well as requiring the organization. Several construction projectsinBanjarbaru City Councilhave been assigned by e-procerument process withinternet based by utilizing information and communication technology. The service is conducted by Electronic Procurement Service Agency (LPSE) which is nationally implemented under the coordination of the Policy Institute for Procurementof Goods and Services. The number of tasks including developing of Procurement SystemServices (LKPP) electronically and establish information systems architecture that supports the implementation of the e-procurement of government projects.LPSE is a unit established to serve the Procurement Services Unit (ULP) or Committee / Procurement Working Group which ULP will implement electronic procurement. LPSE developed in order to answer the challenges of fair competition and the procurement of goods and services are based on the principles of economical, effective and efficient. There are 31 construction project contractsin 2012 to 2015, which 15 contracts are on thespot for analysis.

2.1. Bidding Process

According Wulfram (2004), considerations to think about before following a bid (tender) is the aspect of the project itself, the company's internal, market and resources available. Bidding strategies need to be considered bythe contractor in winning a tender, many ways the strategy undertaken by the contractor in winning the tender, among others, competitive strategy, strategy of lowering prices, loss strategies, payment strategies with clearances and negotiation strategy under the table.According Ervianto (2004), which referred to the strategy is an effort that can be used by users in cementing problems under conditions as real-as real.

2.2. Mark-Up

According Patmadjaja, 1999, Mark-Up is the difference between the offer price with the owner estimate divided by the estimate in the amount of per cent owner. General contractors want to specify a Mark-Up as much as possible, but with hope still want a winner who has the lowest bid. In determining the Mark Up, contractors need the results of the data set that deals ago (historical data) of competitors as a guide in the offer.

2.3. Evaluation of Bidding

It is most influential in the process of selecting providers of goods / services the government is evaluating the bids. Bid evaluation process conducted by the Working Group or the Procurement Committee ULP Provider of Goods and Services by examining and assessing the bid documents submitted by the bidders. Evaluation aims to determine which providers will be the winner, the runner-up and third rank as backup winners. The evaluation was conducted in the manner set out in Presidential Decree number 54 of 2010 amended by Presidential Decree number 70 of 2012 regarding the Second Amendment to the Presidential Decree number 54 of 2010 on Procurement of Goods / Services for the Government and Regulation of the Head of the Policy Institute for Procurement of Goods and Services (LKPP) number 14 of 2012 on Technical Guidelines for the Presidential Decree number 70 of 2012 on the Second Amendment to the Presidential Regulation number 54 year 2010 concerning Procurement of government Goods / Services.

2.4. Contract Type

There are various types of contract used in the process of procurement of government goods / services as a lump sum contract, the contract unit price, lump sum and the combined contract unit price, the percentage of contracts, and contracts received so (turnkey contract). Committing Officer must choose the right type of contract in accordance with the type

of activities / tasks to be carried out. Error in determining the type of contract will not only cause problems in the execution of contracts relating to the agreement between the Commitment Making Official Provider of goods / services as means of payment and possible changes to the contract, but also can lead to errors in determining the winner of the auction by the Working Group on Procurement Unit.

2.5. HPS

Self-Estimated price (HPS) is the calculation of costs for the work of goods and services in accordance with the terms specified in the document election goods and services provider, is calculated based on the expertise and data that can be accounted for. Every provision should be made HPS except procurement using evidence-shaped engagement proof of payment, so HPS is used for the procurement of such agreements with proof of receipt, SPK, and the agreement.

2.6. Estimated Cost

The purpose of cost estimation is to determine the estimated costs necessary to complete a project based on contract plans and specifications of the job. The estimation process must be done carefully so as not to generate fees that are too high or too low. Costs that are too high will result in losing the opportunity to win the tender, unable to compete with competitors who are able to offer a lower price with the same quality of work, on the contrary, if the price is too low then it is likely to win the tender, but with the risk of failure in the implementation process of work. Therefore, the contractor must be able to combine the two things that make a profit from the price proposed and the possibility to get the project can be achieved.

2.7. Construction Cost

The cost of construction is the magnitude of the actual cost incurred for the construction works. The amount of the actual cost of this will be known with certainty when the construction work has been completed. But the cost estimate can not be done after the work is completed and the estimated cost is an important factor in the bid strategy. In penawaean strategy estimated costs must be done before work starts, so it is generally made an assumption that the estimated cost is considered equal to the actual cost.

2.8. Friedman Model

Friedman developed a model based on the assumption that a competitive bidding comparable to the cost of the work. This relationship is based on the argument that the higher the value of the project the more the demand. The reason is developed based on the fact that a growing number of competitors who are interested in a job then the work has a high potential value.

The probability of winning for the identity of the competitors are known or referred to as the probability of beating a competitor, namely:

$$P_{(Win)}=P\ (B_o<B_1)\ *\ P\ (B_o<B_i)\ *.....$$

$$*\ P\ (B_o<B_n)$$

Where:

$P_{(Win)}$ = Probability to win against all known competitors.

$P(B_o<B_i)$ = probability of winning against competitors i

B_o = The offer price contractor who will beat the competitor's bid.

B_i = The offer price of competitor i.

The probability of winning for the identity of the unknown or the probability competitors beat the bid of two or more competitors, namely:

$$P_{(Win)} = 1 / (1 + n\ [(1- P\ (B_o<B_a)) / (P_{(Bo<Ba)})])$$

Where:

$P_{(Win)}$ = Probability to win against all unknown competitors.

B_o = The offer price contractor who will beat the competitor's bid.

B_a = average offer price.

n = number of competitors.

2.9. Expected Profit

According Patmadjaja (1999), the larger the supply price the less likely to be the lowest bidder, so the potential profit to be made known by the optimum profit expected to be the lowest bidder.

The formulation of expected profit:

$$E_{(P)} = [(\text{Mark Up}) \times P_{(Win)}]$$

Where:

$E_{(P)}$ = Expected profit, in %

$P_{(Win)}$ = Probability of winning, in %

Mark Up = Difference in cost of supply to the estimated cost, in %

3. Research Methodology

In this study, the data source is taken from the documentation of the data acquisition process contractor services in Website LPSE Banjarbaru. Data taken from the minutes of the auction results of the project followed by a number of contractors and have been documented in the Office LPSE Banjarbaru. The data taken is the lowest cost estimation data of IDR 20000.00 (two hundred million rupiahs) in accordance with the standards of the lowest cost of procurement through the tender stage. From these data it retrieved the estimated costs of the owner and a great price quotes from contractors following typical winners and other competitors.

3.1. Data Processing

Once all the data is obtained, the next step is the data obtained is converted into deals offer to the ratio of estimated costs (bid/ cost). The steps for analyzing those data are as follows:

1) Calculate the probability of winning the Multi Normal

Distribution using the formulation as follows: Z = (R - Mr) / Dr, Where:Z = Standard normal random variable, R = (1 + Mark Up), Mr = Mean ratio of the data cost bidding contractors, Dr = Standard deviation of the cost of the data deals contractor 2) After Z is calculated, then the probability of winning can be searched on the normal distribution table in the statistical book by looking at the top-right area of the Normal Distribution Figure 1 below:

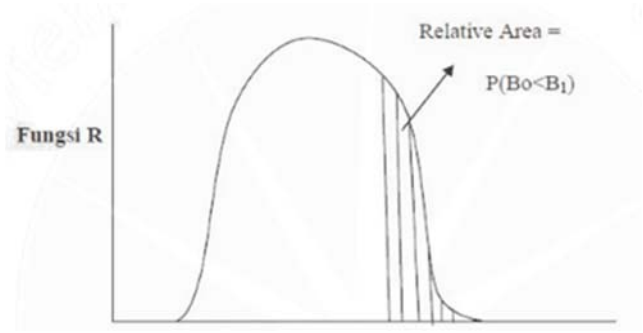

Figure 1.*Normal Distribution.*

Next calculation is the probability of winning with Single Normal Distribution, Multi difference with Normal Distribution is in the Single Normal Distribution winning probability is calculated on the average of all competitors (average bidders) or only on one data only deals that lower bidding data.

3.2. Calculation Friedman Model

Based on the above calculation is then used to calculate the probability of winning of Friedman model as follows:

a. The probability of winning for the identity of the competitor is known
b. The probability of winning for the identity of unidentified competitor
c. Calculating the value of expected profit

4. Analysis of Data and Results

In the testing step, after receiving thirty-one data, it is taken as a sample of the bidding data. Tests are carried out to see if the offer price is lower (which means winning) or higher (which means losing).

Fifteenbidding model used in the study, while one bid is used as the testing of these models. The data is converted into a ratio deals offer to the estimated costs (bid/cost). For the offer price which is less than the estimated cost of the bid Mark-Up its value will be negative. Table 1 below shows the mark-up data of bidding price within 15 bidders as a project contract value.

Next calculation obtaining the values of the mean (average), standard deviation and variance of bid/cost calculated period 2012 to 2015, and the calculation results can be seen in Tables 2 and 3 below:

Table 1. *Mark-up data of bidding price.*

OE(10^3 IDR)	Winner(A)	2nd rank(B)	3rd rank(C)	Mark-up (%)
524.975	478.590	484.499	494.347	-8.84%
3.302.402	3.025.125	3.118.500	3.169.574	-8.40%
248.467	212.858	217.351	222.333	-14.33%
331.750	292.558	296.471	299.807	-11.81%
298.880	279.322	286.544	290.000	-6.54%
1.131.851	996.025	1.013.124	1.091.230	-12.00%
502.738	467.402	482.479	493.350	-7.03%
272.805	251.671	231.200	251.683	-7.75%
596.609	525.527	529.988	558.336	-11.91%
2.729.819	2.326.000	2.394.239	2.497.959	-14.79%
334.460	284.645	299.999	305.786	-14.89%
498.700	458.780	372.657	-	-8.00%
807.400	687.244	695.187	723.054	-14.88%
359.772	312.772	330.940	358.082	-13.06%
323.801	291.000	278.145	292.771	-10.13%

Table 2. *Statisitical analysis result with Multi Normal Distribution.*

Statisitical Analysis	Project Procurement				
	A	B	C	D	E
Mean	0.858	0.877	0.917	0.911	0.962
Deviation Standard	0.037	0.043	0.049	0.039	0.049
Varian	0.001	0.002	0.002	0.001	0.002

Table 3. *Statisitical analysis result with Single Normal Distribution.*

Statisitical Analysis	Value of bidders
Mean	0.890
Deviation Standard	0.052
Varian	0.003

Mean, deviation standard and variance are calculated regarding with the probability of winning on some magnitude Mark-Up ranging from 0% to -25% using Multi and Single Normal Distribution.

The detailed sample calculation winning probability is calculated as follows:

1. Multi Distribution Normal (Normal known bidders), data from the bid / owner magnitude estimate calculated the mean, standard deviation for the period of year 2012 to 2015, then calculated the probability of winning against each competitor.

For example, calculate the probability of winning against competitors A (pA).

To Mark Up value = -19%, obtained

R = 1 + (- 0.19) = 0.81, Mr = 0.858 and Sd = 0.037 and Z

= (0.81 - 0.858) / 0.037 = - 1.29.Based on the value of Z is obtained probability of winning against competitors

A (pA) = 0.901

2. Single Normal Distribution (average bidders), data from the bid / owner magnitude estimate calculated the mean, standard deviation and variance of the average competitor (average bidders) for the period of year 2012-2015. Furthermore, the calculation of the probability of winning against competitors on average.

To Mark-Up value = -19%, obtained

R = 1 + (- 0.19) = 0.81, Mr = 0.890, Sd = 0.052 and Z = (0.81 - 0.890)/0.052 = - 1.58.

Based on the Z value obtained probability of winning against competitors on average (p) = 0.942

4.1. Calculation Friedman Model

The result of the calculation of the probability of winning by using both types of distribution, namely Multi and Single Normal Distribution Normal Distribution is an important element in the use of the probability of winning the formulation of Friedman models.

4.2. Determining the Value Mark-Up

Correlation between mark-up and expected profit with multi normal ditribution is depicted in Figureand Table 4.

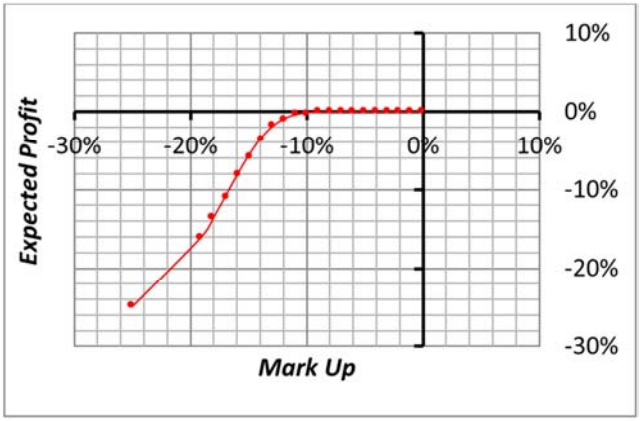

Figure 2. *Correlation Mark-Up and Expected Profit with Multi Normal Distribution.*

Table 4. *Results of the Produce Mark Up Optimum Expected Profit.*

Distribution type	Mark -up(%)	Probability (%)
Multi – normal	-8.84	0.4
Single – normal	-5.00	0.6

Figure 2 shows that the maximum expected profit for the Multi Normal Distribution exist in the Mark-Up of minus 8.84%, while the expected maximum profit for Single Normal Distribution exist in the Mark Up of minus 5%.

4.3. Tests with Data Options

Hypothetically Mark Up optimum obtained from Table to be tested against the price of the winning bid on 15 contracts, by seeing whether it will be lower (which means victory) or higher (which means losing).

Offer hypothesis is obtained by multiplying the estimated cost of the contract 31 with Mark Up optimum, then compared with the lowest bid from the contractor winners.

For the Normal Distribution Multi Mark-Up -8.84% value obtained:

Mark Up = Owner Estimate * Mark Up set
= IDR 524,975,000.00 * -8.84%
= IDR -46,407,790.00

Bid Price Estimate = Owner + Mark-Up
= IDR 524,975.000,00 -IDR 46,407,790.00
= IDR 478,560,210.00

Single Normal Distribution for the Mark Up -5% value obtained:

Mark Up = Owner Estimate x Mark Up set
= IDR 524,975,000.00 * -5%
= IDR -26,248,750.00

Bid Price Estimate =Owner Mark-Up
= IDR 524,975,000.00 - IDR 26,248,750.00
= IDR 498,726,250.00

Table 5. *Results of Testing.*

Cost Estimate (IDR)	524.975.000	
Winner Price (IDR)	478.590.000	
	Mark- Up (IDR)	Bid Price (IDR)
Multi Normal Distribution	-47.247.750	478.560.210
Single Normal Distribution	-26.248.750	498.726.250

4.4. Analysis of Results

By observing the results of the calculation of the optimum Mark-Up in Table 3 can be analyzed as follows:

(1). In a multiNormal Distribution, Friedman models produces optimum Mark-Up with lowering price up to8.84%.

(2). On the Single Normal Distribution, Friedman model produces optimum Mark-Up at 5% lowering the price.

(3). From the test results from the optimum Up Mark Friedman modes with both types of distributions are shown in Table 4 shows that the Normal Distribution Multi can beat the lowest bid while the Single Normal Distribution can not beat the lowest bid.

4.5. Discussion Analysis Calculation

From the description of the analysis of the results of the calculation, the results of discussions in the roomates to use the models of Friedman used in an offer depends on the state of competitors, in terms of whether competitors understand the models, competitors do not need a job Because they have a lot of work so that at the time of bidding would want a big profit or competitors are in need of work.

Calculation of Single Normal Distribution are relatively easy and fast because the calculations are the average of all the offer section with the calculation while the Multi Normal Distribution acres are relatively harder and longer because itmust be considered one by one competitor bidding.

5. Conclusion

After analysis data and analysis results of the calculation then taken some conclusion that is:

(1). (In the Normal Distribution Multi Friedman models produce optimum Mark-Up at loweringto8.84%, while in the Normal Distribution Single Friedman models produce optimum Mark-Up lowest at 5%.

(2). Friedman model can be used to win the tender in the Banjarbaru for the calculation of the Bid Price Mark Up and stated that this type of distribution resulted in the offer price below the winning bidder on the contract number 1.

(3). The tender winner is the bidder who laid the lowest prices without neglecting quality accountability and quality of work.

Suggestions for the use and development strategy model construction project tender offers in Indonesia for future works:

(1). To increase knowledge of competitors, try to find the data contractor deals from open tenders.

(2). For owner and organizer of the tender which encounter case Mark-Up is very low, should be more careful in evaluating the contract documents, although bidders have Mark-Up is very far from the Owner‘s Estimate but the quality and the quality of work should remain the primary.

(3). Need to classify data according to the type of construction work deals.

(4). Need attention to use the data results of the tender offer are more uniform in order to obtain more accurate calculation results and general.

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