

Study of Unit Price for Competitive Bidding Based on CCI (Construction Cost Index) for Building

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Abstract— Competitive bidding on construction projects involving decision making under uncertainty in the form of subjectivity of the bidders. The Bidders who understand these conditions will have the biggest chance to win the tender. The value of the uncertainty to win this tender should be measured based on the factors that influence decisions. This study will be assessed based on economic factors and strategic costs. Contractors generally tend to concentrate their work in geographic locations that they understood clearly. Assessing the unit price offer is essentially the same as reviewing contractual unit price, because it is a contractual winner competitive bidding. Approach to economic factors studied variable CCI (construction cost index) which is the level of construction cost, which reflects a value of the building / construction characteristics of the area. Approach to factor bidding strategies assessed by the difference between the contractual price and the Standard Unit Price for building state. Refer to these conditions then, to get the price of competitive bidding, as well as responsive to the market price. A model is presented in the form of a model $Y = 2,68 X - 0,3734$ will be normally distributed with a standard deviation of 0,4445. Where Y is the unit price of bids (IDR, in millions) And X is CCI Index. CCI is the only driver variables to calculate the standard unit price for building State (HSBGN), by with R^2 is 1, (Abstract)

Keywords— Competitive Bidding, uncertainty, CCI (construction cost index), contractual

I. INTRODUCTION

A. Background

Tender using a competitive bidding system costs is the most difficult faced by the construction contractor. On the supply side must meet minimum profits for the company, but on the other side should also depress the bid price as low as possible to win the tender fatherly construction. Competitive Bidding on construction projects involving decision making under uncertainty in the form of subjectivity of the bidders. The Bidders who understand these conditions will have the biggest chance to win the tender.

The uncertainty may occur in the economic aspects and also on aspects of pricing strategy in winning the tender. With regard to the issues raised, the Indonesian Central Statistics Agency has developed a construction cost index (CCI) for the calculation of unit prices only refer to economic indicators. In fact, at the offer price of construction, aspects influence not only on economic indicators, but also influenced by aspects of the strategy. This strategy indicated aspects of

competition to push prices as low as possible in a bid. based on economic conditions, the research is to formulate a model of the unit price bid summarizes these two aspects, namely the economic aspects and strategy, approach taken is to use the CCI as an indicator of the economy and the difference value of the contract (the lowest bid) to the standard unit price as indicator strategy.

B. Formulation Of The Problem

Based on this background, it can be formulated several problems were more detailed and will be studied in this research is: how CCI effect on the unit price competitive bidding. As follows: How is the correlation the CCI and The Standard Unit Price, Asses the price difference between the standard unit price and the contract unit price, How the model of competitive bidding.

C. Research Objectives

Of the problems to be studied, the study aims: Assess the economic aspects of the relationship between the CCI and The Standard Unit Price, examine aspects of the strategy to see how much influence the competitive bidding, to develop a model of competitive bidding price.

II. LITERATURE

A. Cost Estimate Based On Construction Process

When examined from the construction process and the accuracy of estimates, Kerzner,2006, classify the types of estimates as follows:

1. Order-of-magnitude analysis; these estimates are based on the results obtained from previous similar experience, without the data detail engineering complete with an accuracy of + 35%.
2. Approximate estimate; these estimates are based prorated from previous projects that have a similarity in terms of the scope and number, and also still without the availability of data detail engineering complete with accuracy of + 15%.
3. Definitive estimate; these estimates are based on data from the complete detail engineering such as image detail, price lists, list the quantity of jobs, and others, with accuracy of + 5%.

- The use of the learning curve; This estimate is obtained from a graphical representation of a repetition of the events that take place on an ongoing basis and are commonly used in the estimates for manufacturing activities.

According to Schuette, Liska, 1994, the estimated cost type can also be distinguished by a project cycle stages, namely:

- Feasibility Estimate; is used to determine the appropriateness of whether or not a project to be built during the project owner or an idea put forward plans to build a building.
- Conceptual Estimate; made after the design concept of the building is determined, but there is no detailed plan.
- Elemental or Parametric estimate; is the most accurate estimate of where the information quantity of work on the project has been able to scale very well.

B. CCI (construction cost index)

Construction Cost Index (CCI) is an index number that describes the rate of Construction Cost comparison of a district /municipal or province for construction cost to rate the national average. CCI required to build one unit of the building per unit of measure area in a district / city or province measured through a group of goods and services which are the major trade used on the building. CCI is a driver to illustrate the difficulty level of the geographical region, will increase as more and more difficult to reach the area.

TABLE I. CCI FOR ACEH PROVINCE

District / Municipal	CCI Per Years		
	1	2	3
Aceh Barat	0,9090	0,7646	0,8257
Aceh Barat Daya	0,9590	0,8213	0,8869
Aceh Besar	0,8552	0,7216	0,7795
Aceh Jaya	0,8873	0,7563	0,8168
Aceh Selatan	0,9362	0,7869	0,8500
Aceh Singkil	0,9272	0,7765	0,8384
Aceh Timur	0,8735	0,7537	0,8142
Aceh Utara	0,9451	0,8007	0,8649
Banda Aceh	1,0000	0,7336	0,7922
Bireuen	0,9325	0,7925	0,8560
Lhokseumawe	0,9440	0,7966	0,8604
Nagan Raya	0,8892	0,7455	0,8052
Pidie	0,9034	0,7590	0,8198
Sabang	0,8358	0,8369	0,9037
Simeulue	0,9519	0,9041	0,9765

C. Standard Unit Price for Buildings State

Definition of standard unit price is the unit price the highest standards for physical construction cost of implementing per meter square of Construction for Building of State. The unit price standard enforced in accordance with the classification, location, and year of construction.

Usefulness standard unit price for Indonesia is known as Unit Price Of Building State, that as a guide and control the implementation of the construction of the country starting from the preparation, development, utilization and removal, as a reference for providers and users of services as well as society at large, the realization of the implementation of construction work in an orderly and responsible as well as the demand for higher quality development outcomes.

TABLE II. STANDARD UNIT PRICE FOR BUILDING STATE OF ACEH

District/Municipal	Standard Unit Price Per Years (in Million)		
	1	2	3
Banda Aceh	2,680	1,966	2,123
Sabang	2,240	2,243	2,422
Aceh Barat	2,436	2,049	2,213
Aceh Besar	2,292	1,934	2,089
Aceh Selatan	2,509	2,109	2,278
Aceh Singkil	2,485	2,081	2,247
Aceh Tengah	2,464	2,093	2,260
Aceh Tenggara	2,382	2,000	2,160
Aceh Timur	2,341	2,02	2,182
Aceh Utara	2,533	2,146	2,318
Bireuen	2,499	2,124	2,294
Pidie	2,421	2,034	2,197
Simeulu	2,551	2,423	2,617
Lhokseumawe	2,530	2,135	2,306
Langsa	2,434	2,070	2,236
Aceh Barat Daya	2,570	2,201	2,377
Aceh Jaya	2,378	2,027	2,189
Nagan Raya	2,383	1,998	2,158
Aceh Tamiang	2,417	2,052	2,216
Gayo Lues	2,431	2,042	2,205
Bener Meriah	2,314	2,053	2,217

III. RESEARCH METHODS

A. Location and Object Research

This study conducted a survey on building projects constructed in 15 districts / municipalities in the province of Aceh. Overview of the object of research is focused on buildings with simple classification.

B. Collecting Data

The data collected is in the form of secondary data. The data is obtained from the technical management of the building in relevant institutions. The data needed is as follows:

- The contract price and a building area of the building where collected in 3 years.
- Construction Cost Index (CCI) where collected in 3 years from the Central Bureau of Statistics and the district of Aceh province.
- Standard Unit Prices Standard for construction is set out in Regulation H.S.B.G.N Governor of Aceh Province.

C. Analysis and Processing Data

Data analysis in this study can be explained as follows:

- Data classification by district /municipal and year
- Perform regression between Standard Unit Price and CCI, for the correlation, so it can be estimated model for the economic aspects
- Test of normality data for the difference between contractual and the standard unit price, so that it can be seen a reduction in bid price to win the tender as aspects of the strategy.
- Formulate the model unit price for competitive bidding by considering the economic aspects and bidding strategy, by combining both of these conditions.

IV. RESULTS AND DISCUSSION

In this chapter put forward the results of data analysis is based on research "STUDY OF UNIT PRICE FOR COMPETITIVE BIDDING BASED ON CCI (CONSTRUCTION COST INDEX) FOR BUILDING" in the form of a model for competitive bidding.

A. Result

1) Classification of Data

The data which is the object of this research amounted to 165 buildings, within 3 (three) years and are scattered in 15 provinces of Aceh. Data classification based on average for region, presented in Table III

TABLE III. AVERAGE OF UNIT PRICE PER DISTRICT

District / Municipal	Number Of Project			Average of Unit Price of Contractual			Average of Standard Unit Price		
	Years			Years			Years		
	1	2	3	1	2	3	1	2	3
Aceh Barat	3	3	4	1,447	1,507	1,544	2,436	2,049	2,213
Aceh Barat	3	3	3	1,090	1,352	1,587	2,570	2,201	2,377
Aceh Besar	5	5	3	2,106	2,147	2,324	2,292	1,934	2,089
Aceh Jaya	4	3	1	1,750	1,781	1,817	2,378	2,027	2,189
Aceh Selatan	4	3	3	1,496	1,501	1,831	2,509	2,109	2,278
Aceh Singkil	3	3	3	1,404	1,478	1,559	2,485	2,081	2,247
Aceh Timur	10	6	9	1,952	1,912	2,268	2,341	2,020	2,182
Aceh Utara	5	3	3	1,974	2,139	2,477	2,533	2,146	2,318
Banda Aceh	5	5	4	2,109	1,963	2,352	2,680	1,966	2,123
Bireuen	5	3	3	1,991	2,028	2,105	2,499	2,124	2,294
Lhokseumawe	3	3	3	1,988	2,085	2,275	2,530	2,135	2,306
Nagan Raya	3	2	3	1,242	1,351	1,552	2,383	1,998	2,158
Pidie	3	3	3	2,024	1,990	2,414	2,421	2,034	2,197
Sabang	3	3	3	1,878	2,368	2,534	2,240	2,243	2,422
Simeulue	3	3	4	1,640	1,880	1,944	2,551	2,423	2,617
Grand Total	62	51	52	1,799	1,864	2,069	2,448	2,084	2,263

B. Discussion

1) Effect of CPI and Standard Unit Price

Based on the graph shows that the standard unit price is based on a variable index CCI by R² is 1 and the equation Y = 2,68.X. This model translates the model for the economic aspect, which is represented by a variable CCI.

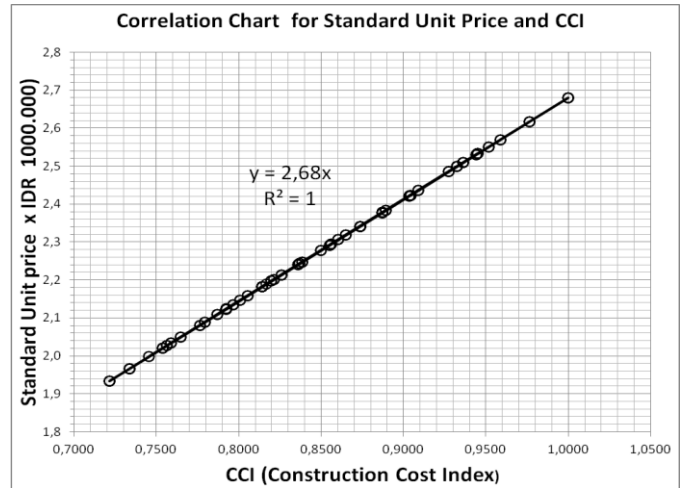


Fig. 1. Correlation Standard Unit Price And CCI

These circumstances it was clear that CCI is the only driver variable for calculating the Standard Unit Price. The equation shows that the standard unit price for the normalization of CCI value equal to 1 is IDR 2.68 million per m2. The price is a reference price for CCI index is one, is Banda Aceh District in year-1.

2) Assessment for Standards and Contractual Unit Price.

2.1 Normal distribution for Difference Contractual and Standard Unit Price

Aspect of the strategy is analyzed using data from the difference between the standard unit price and contractual unit price. The value of the excess is assumed to be normally distributed. Under these conditions, the normal test needs to be done. Data unit price difference between contract and standard unit price are presented in the following table IV.

TABLE IV. DATA OF DIFFERENCE CONTRACTUAL AND STANDARD UNIT PRICE

(0,6370)	(0,0790)	0,0814	(0,6178)	(0,0890)	(0,3510)	0,2880	(0,5153)	(1,6167)	(0,4091)	(0,5647)
(0,2070)	(0,0625)	0,7610	(0,6473)	(0,6012)	(0,2504)	(0,0128)	(0,5553)	(1,1731)	(0,5162)	(0,7966)
(0,2400)	(0,0305)	0,0382	(0,2778)	(0,7180)	(0,3594)	0,1693	(0,5526)	(1,0044)	(1,1235)	(0,6244)
0,1877	0,2413	(0,0928)	(0,1301)	0,0002	(0,8050)	0,0312	(0,6976)	(1,0867)	(1,0135)	(0,6441)
(0,0066)	0,2399	(0,2443)	0,1219	(1,1381)	(0,6310)	(0,0403)	(0,6817)	(0,4550)	(1,1057)	(0,6244)
0,1940	0,2291	(0,6210)	(0,1166)	(0,3339)	(0,3584)	0,6390	(0,5647)	(1,0956)	(0,6605)	
0,2738	0,2055	(0,3249)	(0,0920)	(0,1211)	0,0512	(0,6118)	(0,7285)	(0,4657)	(0,6239)	
(0,1373)	(0,0191)	0,0412	(0,3572)	0,0394	(0,0956)	(0,6368)	(1,1994)	(0,8063)	(0,5221)	
0,2005	(0,3357)	(0,0312)	(0,4517)	0,0612	(0,0856)	(0,6226)	(1,2515)	(1,4954)	(0,8457)	
(0,4089)	(0,2666)	(0,1410)	0,0033	0,2733	(0,1430)	(0,1602)	(0,9705)	(0,8229)	(0,5258)	
(0,6664)	(0,2410)	0,1760	(1,1749)	0,0059	(0,4061)	(0,3191)	(0,5469)	(0,8417)	(0,6906)	
(0,7160)	(0,0668)	0,0276	(0,3861)	0,1981	0,0325	(0,2571)	(0,7465)	(0,8898)	(0,9678)	
(0,3272)	(0,0136)	0,4483	(0,1268)	(0,6120)	0,0443	(0,3720)	(0,5201)	(0,6280)	(0,9301)	
(0,7330)	(0,0009)	(0,5266)	0,3650	0,0884	0,1797	(1,2232)	(0,5411)	(0,5820)	(0,8340)	
0,2401	0,4261	(0,3674)	(0,0143)	(0,2799)	(0,0250)	(0,8779)	(0,7559)	(0,6116)	(0,4811)	
(0,0822)	0,5757	(0,3799)	0,0132	(0,3274)	0,1449	(0,8644)	(1,6492)	(0,4153)	(0,5832)	

Using descriptive statistics obtained -0.3735 average, and standard deviation of 0.4445. Here is presented a scatter plot of the error bar

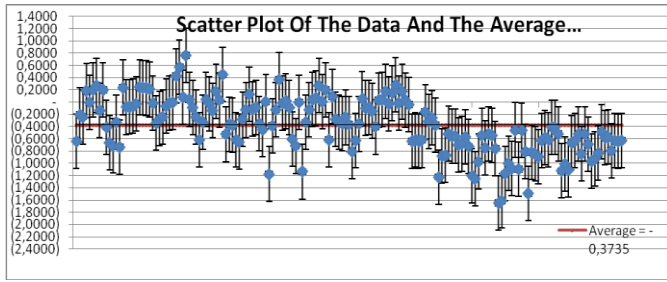


Fig. 2. Error Bar for Difference Contractual and Standard Unit Price

To analyze the effect on the competitive aspects of the bidding strategy, use the Normal Curve analysis. Data which amounted to 165 are grouped into 27 categories (range), as table V.

TABLE V. PROBABILITY CALCULATION OF NORMAL CURVE

Range Of Data	Z	Bins	Number	Density	Cumulative
			Of Data	Probability	Probability
			<i>f</i>	<i>f(z)</i>	<i>F(z)</i>
(1.71) - (1.70)	(2.995)	(1,700)	0	1,0457%	0,1422%
(1.61) - (1.60)	(2.770)	(1,600)	2	1,9951%	0,2898%
(1.51) - (1.50)	(2.545)	(1,500)	0	3,6184%	0,5636%
(1.41) - (1.40)	(2.320)	(1,400)	1	6,2388%	1,0467%
(1.31) - (1.30)	(2.095)	(1,300)	0	10,2261%	1,8570%
(1.21) - (1.20)	(1.871)	(1,200)	2	15,9345%	3,1494%
(1.11) - (1.10)	(1.646)	(1,100)	6	23,6043%	5,1095%
(1.01) - (1,00)	(1.421)	(1,000)	4	33,2405%	7,9362%
(0.91) - (0.90)	(1.196)	(0,900)	3	44,5009%	11,8122%
(0.81) - (0.80)	(0.971)	(0,800)	9	56,6360%	16,8660%
(0.71) - (0.70)	(0.746)	(0,700)	7	68,5235%	23,1314%
(0.61) - (0.60)	(0.521)	(0,600)	22	78,8154%	30,5175%
(0.51) - (0.50)	(0.296)	(0,500)	14	86,1798%	38,7966%
(0.41) - (0.40)	(0.071)	(0,400)	8	89,5826%	47,6207%
(0,3735)	0	(0,3735)		89,74%	50,00%
(0.31) - (0.30)	0.154	(0,300)	14	88,5248%	56,5637%
(0.21) - (0.20)	0.379	(0,200)	9	83,1630%	65,1815%
(0.11) - (0,10)	0.604	(0,100)	8	74,2710%	73,0781%
(0.01) - 0,00	0.829	0,000	19	63,0567%	79,9581%
0.09 - 0.10	1.054	0,100	15	50,8941%	85,6580%
0.19 - 0.20	1.279	0,200	8	39,0505%	90,1479%
0.29 - 0.30	1.504	0,300	9	28,4846%	93,5111%
0.39 - 0.40	1.729	0,400	1	19,7522%	95,9064%
0.49 - 0.50	1.954	0,500	2	13,0210%	97,5286%
0.59 - 0.60	2.179	0,600	1	8,1602%	98,5732%
0.69 - 0.70	2.404	0,700	0	4,8616%	99,2128%
0.79 - 0.80	2.628	0,800	1	2,7534%	99,5851%
0.89 - 0.90	2.853	0,900	0	1,4825%	99,7913%
Total Data			165		
Average				(0,3735)	
Standard Deviation				0,4445	

Normal test data is done by Chi-Square test (using the function Ms Excel), Chi-square count is 49.4092 and Chi-Square table is 40.1132 (level of confidence level is 0.05 and the degrees of freedom 26). The test resulted in Chi-Square test greater than Chi-Square table (value 49,4092 > 40,1132), then it is said to be the difference between Standard and Contractual unit price is Normal distribution (see fig.3).

Based on the above table have been analyzed regarding the difference between the contractual and standard unit price has been distributed Normal. Average of data is -0.3735 and standard deviation of 0.4445. Here is presented a graph of the normal distribution.

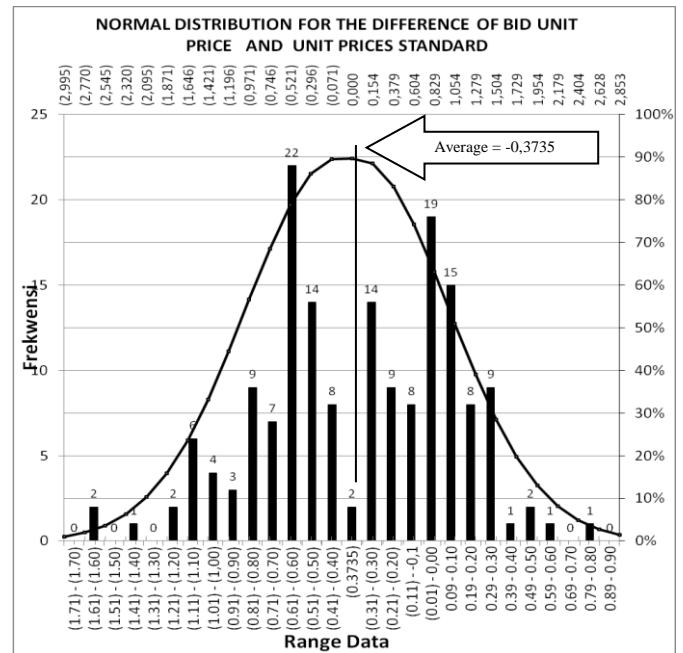


Fig. 3. Normal Curve and Histogram for Difference Contractual and Standard Unit Price

Under these conditions, the model can be formulated from two aspects, economic aspects and aspects of the bidding strategy, namely $Y = 2,68.X - 0.3735$, Where Y as Unit Price for Competitive Bidding (IDR, millions) and X as Index CCI.

2.2 The probability value for Contractual Value Estimation

Based on the normal curve can be determined the probability of the unit price competitive bidding. Probability unit price competitive bidding is under a standard unit price, then gained 80% and for a upper 20%. The possibility of bidding unit price under standard unit price more opportunity.

V. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusion

Based on the results of the discussion in the previous chapter can be deduced, namely:

1. CCI is the only driver variables to calculate the standard unit price for building State, by $Y = 2,68.X$, with R^2 is 1,
2. aspects of the strategy in a competitive bidding has the normal distribution
3. Probability unit price competitive bidding is under a standard unit price, then gained 80% and for a upper 20%.
4. Model for Unit Price for Competitive Bidding is $Y = 2,68.X - 0.4445$, which is X is CCI, Y in million (IDR).

B. RECOMMENDATIONS

1. CCI is an index which plays an important role in setting standard unit price for state buildings of Aceh Province, to the need for further study on the determination or calculation of the CCI index itself.
2. CCI still in normal condition, but needs to be done the accuracy of the CCI, in order to Unit Price for competitive bidding was 95% (confidence level) under Standard Unit Price.

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