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Proportion Of Resource Component Cost In Multi-Story Buildings: Indonesia Case

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Abstract: The construction work contractor must know the proportion of the cost components for materials, tools, and wages. Knowing the ratio of the component's actual costs helps the contractor estimate the new building structure's value. Previous researchers have researched the large proportion of the cost component, but the research has not issued a linear model. The cost component is highly dependent on the management of construction resources on site. Knowing the proportion of the actual cost of structural elements to the building structure budget is very important. Data on cost components and total expenses were obtained from 52 buildings starting on floors 2-9, which have been worked on by intermediate periodical contractors for the last three years—data collection from January to March 2020. The proportion range of component actual cost is the difference between the maximum and minimum proportions. The proportion of actual building costs varies for each building—a linear regression equation balancing each cost component to the actual total cost. Knowing the cost component proportion model helps construction service providers allocate new buildings on time. They were simulating linear equations for estimating realistic component cost. By entering the actual value of the total structural cost with a budget of 90 percent, the proportion of labor, materials, and equipment costs 41.979% respectively; 27,829% and 10,317%. The implication of the results states that the largest ratio of the cost component falls to labor for multi-story building work.

Keywords: *component cost proportion, budget. building structure*

I. INTRODUCTION

SThe proportions of the cost components differ in civil construction work, for road structures (The Department for International Development, 1998), building construction structures (Hanemaaijer, 2014); (Bossink & Brouwers, 1996); (Mujayanah, 2008). Building structural work includes foundations, columns, beams, stairs, plates, windows, and doors. There are several reasons for the cost of building components to change. (Dell Isola, 2011) stated that uncertainty is very high in construction work. Calculating the construction cost budget plan must be based on the analysis of each constituent cost component such as wages, materials, and tools. Many factors affect the building element cost both from inside and outside, even though the type and size are the same (Mubarak, Husin, & Oktaviati, 2017). (Laksono, 2019) even the function of the building as an internal factor. Furthermore, material costs' internal factor component increases because there is material waste from the construction process. According to (Hastuti, Habsya, & Sucipto, 2015), construction material waste comes from planning, procurement, handling, implementation, and residuals.

Available materials affect construction execution where costs increase if the material is delay or speed is on site. Rush (1986) argues that performance measures achievement against intention (Rush, 1986). The fluctuation of prices of materials, cash flow and financial difficulties faced by contractors and shortages of materials were the most significant factors causing cost overrun (Rahman, Memon, & Karim, 2012). . The construction work contractor should adequately control the use of materials in the field. In the practice of construction work, several control methods have been applied, such as the variance of results (Handayani, Setiono, & Winarto, 2017).

The proportion of the cost of construction components differs differently in each building constructed. (Masu, Gichunge, & K'Akumu, 2012) shown that construction cost composition as material 49 percent, plant 4 percent, labor 28 percent, overheads 6 percent, preliminaries 4 percent, and profit 10 percent of the compound unit rate. Use level of materials always fluctuates from one project to others. Stukhart (1996) stated that the allocation of the material cost of projects ranges from 50-70% (Stukhart, 1996). Knowing the linear model of the proportion of component costs to the actual total cost of a multi-story building helps the contractor estimate a new building's price.

(Adi & Yunwanti, 2014) perform risk-based contingency cost estimation modeling for engineering-procurement-construction projects (risk-based contingency cost estimation modeling for engineering-procurement-construction projects). The correlation of each variable with the actual construction cost forms a construction cost model in villas buildings (Al-Mohsin & Al-Nuaim, 2014).

This study is looking for a regression model of the proportion of actual costs to the total cost with floors. The model results predict the amount of budgeted material cost for the project. The linear regression model that has formed is simulated to estimate the proportion of component costs.

II. LITERATURE REVIEW

One of the capital costs of construction work is the costs associated with construction facility costs of labor, materials, and equipment wages. The construction costs consist of direct and indirect costs. Direct costs consist of: a) materials; b) labor and; c) equipment. Indirect costs are not directly related to the construction but should exist on the project. (Ahuja, Dozzi, & Abourize, 1994) suggested items of indirect costs involved access road, project supervisory staff, telephone, transportation, mobilization and demobilization, staff field, guards, security guards, cleanup and housekeeping, permits and licenses, bonding and insurance, safety, and so on. These indirect costs included a) overhead costs; b) unexpected costs; and c) benefits.

(Wuryanti, 2005) states the difference in estimated construction plan costs due to: 1) Calculation of the amount; 2) Material prices; 3) Labor wages; 4) worker productivity and tools; 5) Method of work; 6) Construction equipment costs; 7) Indirect employment costs; 8) Pay for sub-contractors; 9) Pay for material suppliers; 10) lack of understanding of site conditions; 11) Factors of a local nature; 12) Costs related to construction time; 13) Initial implementation costs; 14) Overhead; 15) Consideration of profit; 16) Allocation of unforeseen risks and costs; 17) Errors in the estimation formulation; 18) Basic information commonly used

for the formulation of cost estimates and 19) Market pressures. Management of construction work affects the proportion of component costs (Memon, Rahman, & Aziz, 2002)
Cost is a measurement of construction components. There are various reasons for the different values of construction components. Additional knowledge of construction methods contractors (Bossink & Brouwers, 1996) Costs incurred materials, equipment, wages, and overhead. The share of primary raw materials varies from 5-50%, and for energy and material costs, this is between 20% and 60% (Hanemaaijer, 2014). The survey shows those general component ratios are: material 49 percent, plant 4 percent, labor 28 percent, overheads 6 percent, preliminaries 4 percent, and profit 10 percent of the compound unit rate (Masu, Gichunge, & K'Akumu, 2012). The fluctuation of prices of materials, cash flow, and financial difficulties faced by contractors, and shortages of materials were the most significant factors causing cost overrun (Rahman, Memon, & Karim, 2012).

Construction wage cost

Workforce control significantly affects a construction project's results, both in terms of quality, the time required, and costs incurred as labor wages. Change weather, improper planning, repetitive work add to labor costs (Enshassi, Al-Najjar, & Kumaraswamy, 2009), bad management (Ahady, Gupta, & R.K.Malik, 2017). The size of the labor cost depends on productivity, the applicable wages at the local location, and the workforce's qualifications. For this reason, for the project to run smoothly according to plan, labor control and supervision is crucial. These concerns are related to the number, ability, job skills, and job placement according to their skills and expertise.

Construction Material cost

The control process guarantees that the materials and theft do not occur and the delivery of materials is on time. Alin et al. (2005) suggested that material cost control is done by controlling the material itself (Alin, Bambang, Latif, & Ismeth, 2005). Material costs increase due to changing weather, improper planning, repetitive work (Enshassi, Al-Najjar, & Kumaraswamy, 2009). price fluctuation, inaccurate material estimates. Bad management (Ahady, Gupta, & R.K.Malik, 2017)
anticipating the materials delays from major suppliers need an alternative supplier. The priority list needs appropriately set up. A supplier's quality can be seen from the pattern of habits, a way of delivery, and how to reimburse for damaged goods.
Even though we have already used the best procedure, the problems can arise later on. Sometimes, these happen as a sudden change in plan contractor, such as providing materials to be accelerated the receive dates from the previously decided. Other delays may arise from the supplier, contractor, or in the process of delivery. If the material can not be obtained anymore or be too costly, a particular supplier must know where to get substitute materials to meet or exceed the initial requirements.
Contractors must have the delivery department ensure appropriate materials arrive on time. The failures of material management can cause work delays. As a result, the execution of construction becomes inefficient and ineffective. Contractor must check materials that arrived on site. Routine inspection of material should be held to strengthen the warehouse personnel

records and appropriate action performed when the amount of material stored does not match the document. Materials in construction work are formwork, rebars, and concrete.

Construction Equipment cost

Procurement of equipment for self-owned buildings, renting, and a combination of both. Equipment rental costs are highly dependent on the length of time the equipment leases. Changes in the weather, improper planning, and repetitive work add to equipment costs (Enshassi, Al-Najjar, & Kumaraswamy, 2009), selecting equipment types (Tistogondo, 2004), productivity, and efficiency. In this project, most of the equipment is owned contractor, so the project is more efficient and does not depend on the equipment provider. The leading equipment in multi-story building structures towers crane, motor crane, pili driving, and Concreate pump. furnace and drum.

III. RESEARCH METHOD

The data source comes from several implementing contractors in Jabotabek. There are 52 building samples with details of 2 = 9 floors; 3 = 12; 4 = 9; 5 = 5; 6 = 8; 7 = 5; 8 = 4; . The data collection period for resource component expenditures will last for two months in 2019. The 52 multi-story building structures have already complete. They were determining the construction project sample based on purposive sampling. The type of data taken is the labor component's actual cost: materials, equipment, and total construction costs.

The proportion of the actual cost of each component expressed the comparison of the real value of each element to the budget for construction structure costs multiplied by 100 percent. Meanwhile, the proportion of actual expenses compares all components' actual prices to the account multiplied by 100 percent. The ratio of actual costs more significant than 100 percent indicates an overrun value. The proportion of the actual cost is the maximum proportion minus the minimum. Construction work is categorized as a good performer if the total cost proportion is less than 100 percent.

The equation for the linear regression of each component's actual cost against the total actual price. Furthermore, based on the model formed, the entire real cost value of 90% is tested to obtain the proportion of the cost of building structural work components

IV. RESULT

There are 52 data on expenses for building structural components from 2 to 8 floors and calculating The proportion of costs by comparing the actual cost of building structural elements to the budget multiplied by 100 percent. Table 1 explains that the ratio of labor cost ranges from 17.24 to 86.28 percent and an average of 46.04 percent. The proportion of the material is 33 to 66%, and the standard is 31.56%. The ratio of equipment in the range of 2 to 24% averaged 11.30%.

Table 1 also can be explained in the work of multi-story building structures that the range of the proportion of the actual cost component of labor, material, and equipment is 69.04%, 53%, and 22%.

Table 1.Ratio component of the cost of resources for constructing a 2 to 8 story building structure.

No	budget	Duration	floor	labor	Material	Equipment	actual
1	11.800.000.000	150	2	49	20	6	101
2	4.875.000.000	198	2	59,27	39,8	15,92	117,04
3	15.790.909.578	150	2	51	16	12	100
4	30.864.300.000	170	2	48,82	26,27	17,5	96,23
5	24.200.000.000	150	2	54	16	16	100
6	71.000.000.000	145	2	80	13	3	100
7	11.600.000.000	145	2	76	14	12	106
8	3.000.000.000	120	2	67	14	22	114
9	6.380.390.000	180	2	86,28	14,34	17,34	119,66
Average proportion of building 2 floors				63,49	19,27	13,53	105,99
10	3.385.000.000	222	3	20	59	4	101
11	2.375.327.712	127	3	23	55	3	101
12	9.600.000.000	150	3	80	22	4	111
13	16.386.960.000	180	3	60,05	14,49	16,79	94,84
14	14.141.241.000	180	3	50,73	23,74	13,83	90,64
15	14.072.200.000	150	3	46,95	24,14	15,76	90,05
16	25.586.499.000	120	3	47,48	26,58	15,07	91,28
17	9.800.000.000	150	3	46	20	23	118
18	6.100.000.000	150	3	44	21	24	120
19	10.800.000.000	150	3	48	20	24	120
20	13.360.000.000	185	3	70	13	9	112
21	137.000.000.000	480	3	18	26,56	6,57	66,13
Average proportion of building 3 floors				46,18	27,13	13,25	101,33
22	12.600.000.000	140	4	79	24	4	111
23	37.350.000.000	180	4	38,79	13,54	10,96	66,35
24	25.649.000.000	180	4	53,04	26,16	14,78	96,37
25	62.710.560.000	116	4	46,08	25,31	16,06	90,91
26	27.270.647.000	118	4	44,1	25,23	13,83	85,74
27	39.689.800.000	195	4	47,86	25,63	14,91	90,49
28	16.909.405.000	127	4	45,64	14,9	5	67,85
29	122.000.000.000	192	4	61	28	2	100
30	206.121.434.955	729	4	32	55,7	7,45	104,45
Average proportion of building 4 floors				49,72	26,50	9,89	90,35
31	13.701.084.818	156	5	28	48	8	99
32	5.882.631.000	164	5	28	44	10	100
33	11.773.300.000	145	5	28	47	8	99
34	28.395.800.000	210	5	52,73	27,39	15,46	96,82
35	140.320.886.094	315	5	17,24	36,08	8,96	75,28
Average proportion of building 5 floors				30,794	40,494	10,084	94,02

36	49.696.797.273	210	6	26	56	5	100
37	73.557.677.000	360	6	23	66	8	100
38	33.827.272.727	360	6	20	56	9	101
39	14.650.000.000	217	6	21	52	14	101
40	39.465.151.514	340	6	24	47	8	93
41	19.130.700.000	180	6	50,95	16,32	14,28	88,98
42	85.400.000.000	168	6	62	15	22	110
43	607.973.000.000	364	6	41,64	34,82	7,49	92,85
Average proportion of building 6 floors				33,57	42,89	10,97	98,35
44	21.086.217.636	175	7	20	55	8	100
45	18.837.280.000	217	7	25	50	8	99
46	49.455.600.000	130	7	46,01	35,83	15,76	99,59
47	64.200.000.000	450	7	56	19	11	100
48	120.363.636.332	490	7	49,7	38,26	8,27	105,41
Average proportion of building 7 floors				39,342	39,618	10,206	100,8
49	96.000.000.000	156	8	74	20	2	101
40	30.407.000.000	149	8	54,48	23,1	12,4	93,72
51	24.369.000.000	147	8	60,88	14,22	16,48	93,69
52	34.167.000.000	160	8	47,31	42,9	13,73	105,82
Average proportion of building 8 floors				59,17	25,06	11,15	98,56
Average total proportion				46,04	31,56	11,30	9,59

Source: processed construction work cost data

Meanwhile, based on the number of floors, the proportion of component costs for the second-floor building structure: material 63.49%; material 19.27. Equipment 13.53. 3rd floor: 46,18; 7,13; 13.25. 4th floor: 49,72; 26.50; 9.89. 5th floor: 30,794; 40,494; 10,084. 6th floor: 33,57; 42.89; 10.97. 7th floor: 39,342; 39,618; 10,206. Floor 8: 59,17; 25.06; 11.15

The difference in the proportion of the actual cost of each component is not the same in each high-rise building, suggesting that construction work has high uncertainty. Although the number of floors and types are almost similar, the costs incurred are different. Many factors cause differences both from inside and outside. Table 2. Unstandardized Coefficients in linear regression between labor and total cost

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-10.581	19.556		-.541	.591
	Total	.584	.197	.384	2.967	.005

From table 2, a linear equation formed between labor and total cost

$$Y_1 = 0.584X_1 - 10.581$$

Table 3. Unstandardized Coefficients in linear regression between the material and total cost

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		

1	(Constant)	26.129	17.500		1.493	.142
	Total	.039	.176	.031	.223	.824

From table 3, a linear equation is formed between material and total cost

$$Y_2 = 0.039X_1 + 26.129$$

Tabel 4. Unstandardized Coefficients in linear regression between the equipment and total cost

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-2.463	6.528		-.377	.708
	Total	.142	.066	.290	2.162	.035

From table 4, a linear equation formed between the equipment and total cost

$$Y_3 = 0.142X_1 - 2.463$$

Where Y1 actual labor cost, Y2 actual material cost, Y3 equipment cost and X1 total cost

The project profit is usually expected to be 10 percent of the budget so that the total cost value is 90% (X1). By substituting the X1 value of 90, the proportion of labor, material, and equipment is 41.979% respectively; 27,829% and 10,317%

V. DISCUSSION

The actual cost of the structural components of the construction varies for all constructed buildings. External factors and within the project location affect the size of the difference. Many research results show that there are differences in each cost component. The difference in the proportion of costs in this study also occurs in multi-story buildings based on the number of floors, but the tendency is not linear. Existing reality reinforces the opinion that the construction industry is full of uncertainty.

The experience of contractors working on construction work at the same location is beneficial in estimating costs. Fluctuations in material prices, workforce experience, differences in equipment and work methods, design errors, worker competence, repetitive work greatly affect construction costs. Repetitive work due to poor work management increases costs by up to 25%. (Miri & Khaksefidi, 2015). This research is interesting to complete the results of this study

The proportion of labor costs took 17.24 - 86.28 percent, stating that labor costs vary from one building to another. Labor costs influence wages applicable at the project site, the level of productivity, skills and expertise, education level, project delays; even though workers only work 2 hours due to constraints in the field but wage payments by day system. Cost of labor components 30-50%

Materials are classified into temporary and fixed materials. The proportion of material costs from 33 to 66%, 50-70% (Stukhart, 1996) varies for various reasons. According to references and observations in the field, there are several reasons for price fluctuations (A.S. Ali, 2010), the level of material damage, waste, method of use, payment to suppliers, theft, too fast procurement, delays. Repetitive work due to wrong planning makes much material wasted. A large amount of material wasted due to repeated work has become interesting research and a hot related issue in the field of construction waste furthermore. Reducing repetitive work,

reducing material waste contributes to reducing unnecessary costs. In the application in the field, contractors often ignore it

The proportion of equipment costs from 2 to 24% varies. The way of procurement affects the cost of the equipment. In general, contractors procure equipment by renting, buying, or a combination thereof. Apart from that, the level of equipment productivity, the way the operator operates it, and delays are the main causes of cost variations. Also, site conditions, nature of work, characteristics of equipment, use of fuel influence costs. Limited movement of equipment such as tower cranes often results in low productivity resulting in increased equipment costs.

VI. CONCLUSIONS

1. The most significant factor affecting the size of the cost of construction work.
2. The proportion of component costs varies based on the number of floors, types, and types of buildings
3. the actual value of the total structural cost with a budget of 90 percent, the proportion of labor, materials, and equipment costs 41.979% respectively; 27,829% and 10,317%.

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