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THE INFLUENCE OF COST ESTIMATES, CONTRACT MANAGEMENT, EQUIPMENT COSTS, MATERIAL COSTS AND LABOR COSTS ON COST EFFICIENCY IN ROAD INFRASTRUCTURE DEVELOPMENT PROJECTS

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ABSTRACT: *One of the final goals of the project is the achievement of cost performance, therefore good project cost management is needed. Project cost management includes the processes required to ensure that the approved budget is sufficient to complete all work within the project scope. The objectives of the study are: 1) To analyze the variables of cost management performance which predominantly affect the cost performance of the project, and 2) These variables can be applied and considered in the cost management process in order to avoid swelling and deviation of project costs and achieve cost budget efficiency. By using RII analysis, the third highest ranking is number of workers in the maximum period. The second indicator is material technical specifications that are included in the material category and the third, taxes are also included in the material category. Cost estimation affects the cost efficiency of road infrastructure projects at PT X, contract management affects the cost efficiency of road infrastructure projects at PT X, equipment costs affect the cost efficiency of road infrastructure projects at PT X, material costs affect the cost efficiency of infrastructure projects roads in PT X, labor costs affect the cost efficiency of road infrastructure projects at PT X and cost management performance variables, namely cost estimation, contract management, equipment costs, material costs and labor costs collectively on cost efficiency*

KEYWORDS: cost efficiency, cost estimation, contract management, equipment costs, material costs and labor costs

INTRODUCTION

One of the final goals of the project is the achievement of cost performance, therefore good project cost management is needed. Project cost management includes the processes required to ensure that the approved budget is sufficient to complete all work within the project scope. Cost management consists of planning, estimating, budgeting and controlling operations to complete the project within the approved budget (Kasem and Alhaffar, 2011). In project implementation, there are many projects that experience cost overrun, time delays, and changes in work either at the beginning of the construction stage or at the previous stage.

Some of the dominant factors that influence cost overrun are cost estimates, implementation and work relationships, project document aspects, materials, labor, equipment, project financial aspects, economic and environmental feasibility implementation time (Fahadila, 2017). The process of estimating and controlling costs (cost control) which is part of cost management plays an important role and has an impact on the success of a project and to prevent cost overrun and to keep costs in accordance with the agreed budget. The accuracy of cost estimation and control depends on the expertise and accuracy of an estimator and cost control in following the entire work process according to the latest information. The main problem that generally occurs in a construction implementation project is the deviation of the actual project cost from the initial estimated cost and even though cost control has been carried out, cost overrun often occurs so that both of these things have an impact on the project cost performance. is not achieved and the project becomes inefficient

LITERATURE REVIEWS

Project Cost Management

One of the three obstacles to the success of any project apart from time and quality constraints is the cost constraint which contains financial principles and figures and includes human resources, material, equipment, services and transportation, therefore cost management must be applied effectively. Cost management consists of three operations, namely cost estimation, budgeting and cost control, each of which has different techniques and tools as described in Figure 1 (PMBOK, 2008).

Project Cost Estimation

There is some literature that discusses the notion of cost estimation. According to (AACE International, 2004) estimation is an evaluation of all elements of a project or effort that is given based on agreement on a scope of work. To estimate costs, there are several ways or methods, according to available information or the construction stage. The cost estimation methods can be divided into four main categories (Dell'Isola, 2002).

Project Cost Control

Control is a series of activities that must be carried out to carry out supervision, improvement, and assessment to ensure that the objectives can be achieved as stipulated in the planning. (Soejadi, 1996).Cost control is responsible for tracking the flow of costs against a predetermined budget (Wideman, 1995) materials are raw materials that are processed by industrial companies that can be obtained from local purchases, imports or self-processing (Mulyadi, 2000). Good materials usually require large costs, need good sources of materials at low costs. and thirdly, taxes are compulsory contributions in the form of money or goods collected by the authorities based on 11 legal norms, in order to cover the costs of producing collective goods and services in achieving general welfare (Waluyo, 2011: 2) According to Soemardi, (2007): Resource planning is a process for determining resources in physical form (human, equipment, material). Cost estimation which is

the process of estimating the cost of the resources required to complete a project. Cost budgeting is the process of making cost allocations for each activity from the total costs that appear in the estimation process and then cost control is carried out during the project to detect whether the actual costs of project implementation deviate from the plan or not. According to Pratt (1995) the function of cost estimation in the construction industry is: to see whether the estimated construction costs can be met with existing costs, to regulate the flow of funds when construction is underway and for competition at the time of bidding. According to (Rohman, 2003) implementing a construction project means combining various resources to produce the desired final product, in a construction project the need for equipment is between 7 - 15% of the project cost. Material is something that is composed or made by materials (Callister & William, 2009). According to Sumarni (2014), labor is an individual who offers the skills and ability to produce goods or services so that the company can make a profit and for that the individual will get a salary or wage according to his / her skills.

METHODS

This study uses a survey with multiple regression analysis techniques that are quantitative and causal-comparative, which aims to prove the causal relationship or the relationship that affects and is influenced by the variables studied. From the results of the responses from the correspondents regarding the cost management performance factors that affect cost efficiency, an analysis of the Relative Importance Index (RII) calculation is carried out. RII is used as a ranking technique for each statement and compares the responses received from the four respondents consisting of the Project Manager, Site Manager, Site Engineer, Supervisor, Cost Control, and estimator at the construction service company PT. X who worked on the company project in 2017-2019.

The population in this study were the Project Manager, Site Manager, Site Engineer, Supervisor, Cost Control and Estimator at the construction service company PT. X who worked on the project at the company from 2017-2019. Withdrawal of sample members by sampling technique is a way of determining the size of the members of the study sampling and the population size based on certain techniques. Withdrawal of sample members by sampling techniques, where the results are expected to represent the characteristics of members of the study population. The population in this study using a random sample (Random Sampling).

RESULTS

Results of Relative Importance Index (RII)

The RII test applied to 50 respondents with 50 variables was processed using the Microsoft Excel application. For a comprehensive and detailed calculation can be seen in full in the table below:

Table 1. Result of RII Test

No. Indicator	Attributes	RII	Rank
X33	The number of workers in the maximum period	0,776	1
X23	Material technical specifications	0,772	2
X26	Tax	0,764	3
X18	Weather conditions	0,756	4
X17	Field Conditions	0,744	5
X24	Scope of offer	0,744	6
X34	The number of permanent and non-permanent workers	0,744	7
X38	Source of labor	0,732	8
X19	Operator ability	0,728	9
X22	Quality of material	0,728	10
X1	Estimator Team Experience	0,724	11
X37	Skills	0,724	12
X27	Logistic payment terms / conditions	0,720	13
X2	Time taken to prepare estimates	0,708	14
X10	Agreement / contract instrument	0,704	15
X25	Delivery time	0,704	16
X21	Source of Equipment	0,684	17
X28	Material supplier	0,672	18
X11	Budget plan	0,664	19
X16	Activity duration	0,660	20
X20	Capacity and number of tools	0,660	21
X36	Labor productivity	0,660	22
X35	Workforce expertise	0,652	23
X29	Storage of materials	0,644	24
X30	Material bidding price	0,640	25
X12	Job Specifications	0,628	26
X3	Quality of information	0,608	27
X31	Schedule of material use	0,604	28
X14	Correspondence between contracting parties	0,600	29
X7	Unit price analysis	0,592	30
X5	Selection of work methods	0,588	31
X9	Job volume	0,588	32
X8	Type of work	0,580	33
X4	Currency exchange rate fluctuation	0,576	34
X13	Plan drawing	0,564	35
X6	Estimation method	0,560	36
X15	Aanwijzing	0,524	37
X32	Source of material	0,496	38

Based on table 1, it can be explained that the highest rank of RII for is X33 (number of workers in the maximum period) which is one of the workers with the definition of labor is the entire number of people who work in completing road infrastructure projects. The second indicator is the technical specifications of the material which are included in the material category and the third is taxes which are also included in the material category.

Table 2. Result of RII Test for Variable Level

Variable	No. Indicator	General Indicators of the Cause of Efficiency	RII		Rank
			Kel	Mean	
Labor costs (X5)	X33	The number of workers in the maximum period	0,776	0,7147	1
	X34	The number of permanent and non-permanent workers	0,744		
	X35	Workforce expertise	0,652		
	X36	Labor productivity	0,660		
	X37	Skills	0,724		
	X38	Source of labor	0,732		
Tool Cost (X3)	X16	Activity duration	0,660	0,7053	2
	X17	Field Conditions	0,744		
	X18	Weather conditions	0,756		
	X19	Operator ability	0,728		
	X20	Capacity and number of tools	0,660		
	X21	Source of Equipment	0,684		
Material Cost (X4)	X22	Quality of material	0,728	0,6807	3
	X23	Material technical specifications	0,772		
	X24	Scope of offer	0,744		
	X25	Delivery time	0,704		
	X26	Tax	0,764		
	X27	Logistic payment terms / conditions	0,720		
	X28	Material supplier	0,672		
	X29	Storage of materials	0,644		

	X30	Material bidding price	0,640		
	X31	Schedule of material use	0,604		
	X32	Source of material	0,496		
Contract Management (X2)	X10	Agreement / contract instrument	0,704	3,684	4
	X11	Budget plan	0,664		
	X12	Job Specifications	0,628		
	X13	Plan drawing	0,564		
	X14	Correspondence between contracting parties	0,600		
	X15	Aanwijzing	0,524		
Cost Estimation Process (X1)	X1	Estimator Team Experience	0,724	0,6138	5
	X2	Time taken to prepare estimates	0,708		
	X3	Quality of information	0,608		
	X4	Currency exchange rate fluctuation	0,576		
	X5	Selection of work methods	0,588		
	X6	Estimation method	0,560		
	X7	Unit price analysis	0,592		
	X8	Type of work	0,580		
	X9	Job volume	0,588		

Hypothesis Testing

After calculating the value per group of variables, the same results were obtained, rank 1 was from the variable group of labor, which consisted of 6 factors, namely the number of workers in the maximum period (X33), the number of permanent and non-permanent workers, skill of the workforce, Labor productivity, skills and labor resources. This proves that the cost efficiency of a project still really needs labor factors in implementing an efficient project.

Before hypothesis testing, first calculated R-square test aims to determine the contribution or percentage of the independent variables to the rise and fall of the dependent variable. The following are the results of calculations using SPSS

Table 3. R-Square

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.872[a]	.760	.732	.0923

a. Predictors: (Constant), labor cost, contract management, cost estimation process, tool cost, material cost
b. Dependent Variable: efficiency

Based on the calculation results from SPSS as shown in Table 3, it is obtained that the R-square = 0.760 or 76%. These results indicate that the cost management performance variables collectively determine the variation or rise and fall of the cost efficiency variable by 76%. While the remaining 24% is explained by other variables not involved in this research model.
Furthermore, to test the effect simultaneously, the F test was used with the following results.

Table 4. F Test

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.185	5	.237	27.798	.000[b]
	Residual	.375	44	.009		
	Total	1.560	49			

a. Dependent Variable: EFISIENSI
b. Predictors: (Constant), TENAGA KERJA, MANAJEMEN KONTRAK, ESTIMASI, BIAYA ALAT, BIAYA MATERIAL

From the calculation results as shown in table 4 above, the significance level is obtained 0.000 <0.05 or F count = 27.798> F table = 2.237. Thus it can be concluded that there is an influence of cost management performance variables on cost efficiency (Y).

Next calculated multiple regression analysis is used to determine the effect of two or more independent variables (X) on changes in the dependent variable (Y), the results of which are shown in the following table:

Table 5. Regression Results

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.648	.063		10.247	.000
	cost estimation	.004	.002	.200	2.168	.036
	Contract management	.006	.003	.215	2.263	.029
	Tool cost	.007	.003	.244	2.379	.022
	Material cost	.005	.002	.278	2.328	.025
	Labor cost	.007	.003	.210	2.110	.041

a. Dependent Variable: efficiency

The table above is the result of multiple regressions from the research model on the effect of cost management performance variables on cost efficiency (Y). From the calculation results, the multiple regression equation can be written as follows:

$$\widehat{Y} = 0,648 + 0,004X_1 + 0,006X_2 + 0,007X_3 + 0,005X_4 + 0,007X_5$$

Based on the results of multiple regression analysis, it shows that the cost estimation process, contract management, equipment costs, material costs and labor costs are positive, indicating that if these variables increase, the value of cost efficiency will also increase, and vice versa.

Based on the results of the calculations shown in table 5 it can be concluded follow: First, the results of the research on the effect of cost estimation on the efficiency of project costs show that the t value of 2.168 is greater than the t table, with a sample size of 50 and 5 independent variables and the value of $\alpha = 0.05$ is 2.014 and the significant value is less than the value of $\alpha = 0.05$ (0.036 <0.05), it can be concluded that there is an effect of cost estimation on the cost efficiency of road infrastructure projects at PT X

Second, the results of the research on the effect of contract management on project cost efficiency show that the t value of 2.263 is greater than the t table of 2.014, and the significant value is less than the value of $\alpha = 0.05$ (0.029 <0.05), it can be concluded that there is an effect of contract management on on the cost efficiency of road infrastructure projects at PT X.

Third, the results of the research on the effect of tool costs on project cost efficiency show that the t value of 2.379 is greater than the t table of 2.014, and a significant value is less than the value of $\alpha = 0.05$ (0.022 <0.05), it can be concluded that there is an effect of tool costs on on the cost efficiency of road infrastructure projects at PT X.

Fourth, the results of the research on the effect of material costs on project cost efficiency show that the t value of 2.328 is greater than the t table of 2.014, and the significant value is less than the value of $\alpha = 0.05$ (0.025 <0.05), it can be concluded that there is an effect of material costs on on the cost efficiency of road infrastructure projects at PT X.

Fifth, the results of the research on the effect of labor costs on the efficiency of project costs show that the t value of 2.110 is greater than the t table of 2.014, and the significant value is less than the value of $\alpha = 0.05$ (0.041 <0.05), it can be concluded that there is an effect of labor costs. work towards cost efficiency of road infrastructure projects at PT X.

DISCUSSION

By using RII analysis, the highest rank is X33 (number of workers in the maximum period), the more the number of workers, the efficiency will be reduced, for this reason, the labor during the maximum period will make a large expenditure on the project budget. Second, the technical specifications of the material.

After calculating the value per group of variables, the same results were obtained, rank 1 was from the Labor Variable Group, which consisted of 6 factors, namely the number of workers in the maximum period (X33), the number of permanent and non-permanent workers, the expertise of the workforce, Labor productivity, skills and labor resources. This proves that the cost efficiency of a project still really needs labor factors in implementing an efficient project. The second is the equipment cost group which is a group factor that must be considered in increasing project efficiency.

The results of this study indicate that based on the results of statistical testing, the cost management variable has a significant effect on the project cost efficiency at PT X. This is based on the results of the calculated F value greater than the F table, cost management consisting of 5 variables, namely cost estimation, contract management. , equipment costs, material costs and labor costs.

First, there is an effect of the cost estimation process on the efficiency of project costs. Cost estimation must have been carried out since the project conception stage, so that project cost estimates can be carried out properly so as to produce accurate cost estimates. Cost estimates are used to prepare budgets and serve as the basis for evaluating project performance. Evaluation is done by comparing the level of actual expenditure with the level of budgeted expenditure. Thus, without a good estimate, it will be difficult for an effective and efficient evaluation.

Second, there is an effect of contract management on project cost efficiency. Contract management or contract management is the process that deals with company contracts. This can be a contract with a customer, supplier, distributor or contractor. This term is often referred to as contract administration (https://cerdasco.com/mana Manajemen-kontrak/).

Construction contract is a process where the project owner makes a bond with the agent with the task of coordinating all project implementation activities including feasibility studies, design, planning, preparation of construction contracts and others, project activities with the aim of minimizing costs and schedules and

maintaining project quality. The better the contract management, the higher the level of cost efficiency in a project.

Third, there is an effect of the cost of the equipment on the project cost efficiency. Selection of heavy and light equipment as well as scheduling for each type of work is very important so that these tools can operate optimally. The cost of using heavy equipment is relatively expensive and plays an important role in the implementation of work on the project. Therefore, the selection, purchase and scheduling of project tools need to be done properly and efficiently in order to increase project cost efficiency.

Fourth, there is an effect of material costs on project cost efficiency, in this study based on the t test partially it shows material costs have an effect on cost efficiency., The material costs in a project usually already have a fixed supplier at a low price compared to other suppliers, suppliers, materials deliver goods directly to the place of destination, with the same cost and price, then the material costs in this study have a partial effect on project cost efficiency.

fifth, there is an effect of labor costs on project cost efficiency. Labor is the most difficult aspect of the overall construction cost analysis. There are many influencing factors that must be taken into account in selecting the workforce, working conditions, skills, length of time worked, population density, competition, productivity, and the local cost of living index. the better skilled labor and relatively cheap costs, the higher the level of cost efficiency of a project.

CONCLUSION

The results of this study conclude that by using RII analysis, the third highest ranking is X33 (number of workers in the maximum period). After calculating the value per group of variables, the same results were obtained, rank 1 was from the labor variable group, which consisted of 6 factors, namely the number of workers in the maximum period (X33). The second is the equipment cost group which is a group factor that must be considered in increasing project efficiency. The results of hypothesis testing show that partially the variable cost estimation, contract management, equipment costs, material costs, and labor costs have a significant effect on project cost efficiency. Similarly, the variable cost estimation, contract management, equipment costs, material costs and labor costs simultaneously have a significant effect on cost efficiency.Based on the conclusions of the results of this study it is suggested that companies should pay attention to internal company factors, by paying attention to and improving the quality of existing human resources with training, building good internal communication and creating a solid team, because internal factors are the most influential factor in increasing project cost efficiency. The companies should adapt to technology, namely in the form of using more modern tools to replace project tools with high operational levels, use work equipment properly and correctly and carry out regular maintenance of project tools. Additionally, the company should evaluate a project when it has been completed. The objective is to determine the relevance and level of achievement of

the success of the project objectives, development effectiveness, efficiency, impact, and also project sustainability. Evaluation can also provide lessons for project stakeholders in making decisions in the future.

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