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Value Engineering Study on Canal Rehabilitation Work Using Cultures in Samarinda Ulu District

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Abstract: This research was conducted with the aim of analyzing the Engineering Value of Drainage and Culvert Rehabilitation Work in Samarinda Ulu District. The settlement method for this calculation uses Value Engineering Analysis. Value Engineering Analysis is carried out when the Budget Plan (RAB) is still being planned to get maximum results. This research method was carried out in five stages of Value Engineering, namely the information stage, function analysis stage, creative stage, evaluation stage and presentation stage. Weight of each criterion using the Zero-One Method. Zero-One Analysis Matrix Method The zero-one method is used for weighting and assigning scores to criteria. From the results of the analysis, it was found that the best alternative that can replace the initial implementation method for selected work items in concrete work is Precast Reinforced Concrete Partially Cast Ready Mix Reinforced Concrete. The cost of concrete work, namely at the beginning or according to plan, is Rp. 623,679,984.00 Costs for concrete work after VE, namely Rp. 271,933,824.09 With costs saved amounting to Rp. 352,393,548.00 or 18.3%. The overall project cost for the initial plan is Rp. 2,099,885,844 while the overall cost of the project after VE is IDR 1,748,139,684. With the cost savings of Rp. Rp. 352,393,548.00 or 16.78% of the total project.

Key word: Value Engineering, Zero-One Methode, concrete work, Matrix Method

INTRODUCTION

The main problem with urban drainage is flooding, which is a very common issue in big cities, especially during the rainy season. Almost all cities in Indonesia experience flooding every year, and this problem has not been resolved and tends to worsen in terms of frequency, depth and duration. To overcome this problem, management is needed which includes planning a good drainage system, making detailed plans, restructuring institutions and related regulations, as well as community participation in overcoming drainage problems. Cities are places for many activities, so to ensure the health and comfort of residents, adequate sanitation is needed, such as drainage. Drainage helps drain pools of rainwater to prevent flooding and reduce health impacts and disruption of community activities (Halim, 2011). Drainage is a facility created to reduce excess surface water from rain, seepage, or excessive irrigation. With increasing population and infrastructure development, the need for drainage also increases (Suripin, 2004). The city of Samarinda faces the problem of waterlogging when it rains in several areas due to damaged drainage channels, such as in Samarinda Ulu. This damage causes water flow not to flow smoothly and accumulation of sediment at the bottom of the channel. Wesli (2008) stated that high intensity rainfall causes excess water which results in puddles, which if not immediately resolved, will disrupt community activities.

The Samarinda regional government is carrying out a vital drainage project and requires a large budget, so planning the work from start to finish must use value engineering methods to evaluate the cost performance of the project. This research aims to analyze Value Engineering in drainage channel rehabilitation work in Samarinda Ulu District.

Projects are temporary activities that last for a certain period of time with specific resource allocation to achieve certain goals (Rifai & Soekiman, 2014). Construction projects include all activities related to development, such as buildings, civil infrastructure (roads, water structures, docks), and installations. Value Engineering is a multidisciplinary, systematic and structured decision-making process. This involves analyzing functions to achieve the best value for a project by defining the functions required to achieve the desired value at optimal cost, consistent with the required quality and performance (Berawi, 2013). Drainage, from the word 'to drain' which means to drain or drain water, refers to a system that handles excess water, both above and below the ground surface. Urban drainage is a system within a city area that functions to control or reduce excess surface water in residential areas from local rain, so that it does not disturb the community and is beneficial for human life. Generally, urban areas have a distance between buildings of no more than 200 meters and a population of more than 2000 people (Angelakis et al., 2017).

METHODOLOGY

In this research study, the Samarinda Ulu District drainage channel rehabilitation work project will be discussed. The research carried out is quantitative descriptive research, namely research that describes the subject or object being studied using the results of data analysis in the form of numbers, where each stage is the part that determines how to proceed to the next stage. Research begins with an assessment of the problem then refers to a literature review. Based on the literature review, research data was collected consisting of primary data and secondary data. The data is then analyzed using the value engineering method and following several stages until the evaluation and conclusion drawing stage (figure 1).

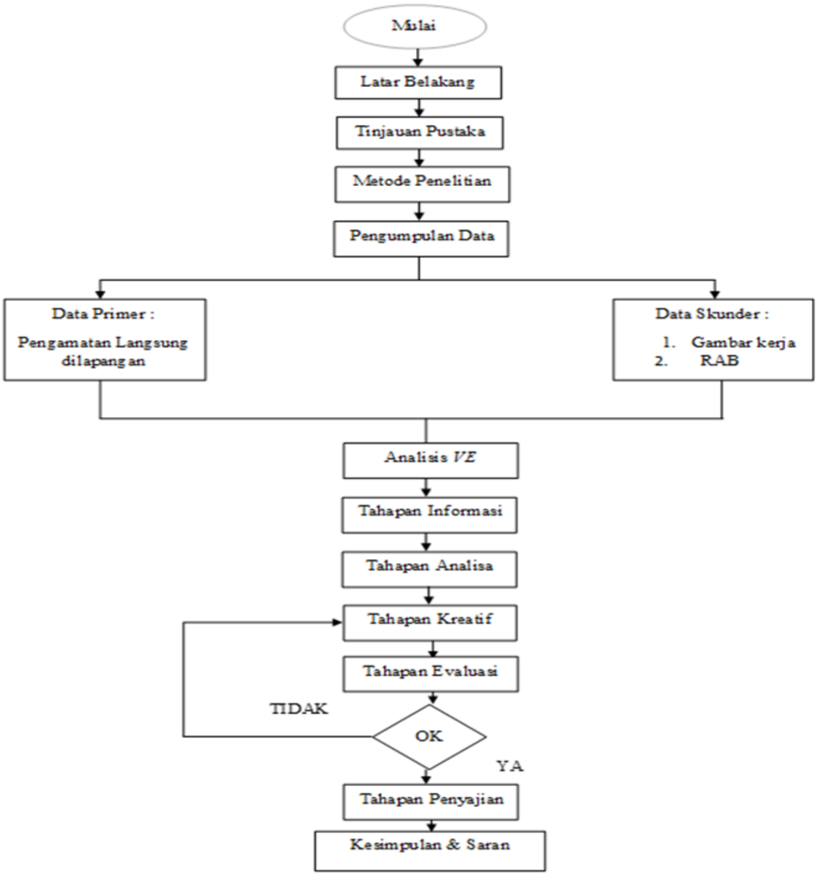

Figure 1. Research Flow Chart

RESULTS AND DISCUSSION

In this research, the application of value engineering to projects uses an analysis stage called Value Engineering. These stages include the information stage, creative stage, analysis stage, development stage and reporting stage. Data processing in the application of value engineering follows several steps:

a. Information Stage: Gathering information relating to all aspects of the project.
b. Creative/Speculation Stage: Looking for alternative jobs that have a large cost/worth value.
c. Analysis Stage: Filter the advantages and disadvantages of alternatives/creatives. These advantages and disadvantages are analyzed by establishing several assessment criteria.
d. Development Stage: Developing alternatives that have been selected based on an analysis of advantages and disadvantages.
e. Reporting/Recommendation Stage: Make a report regarding the activities and results that have been carried out in the value engineering process.
f. All the stages above will be explained in detail as follows. Information Stage

The project examined in this research is the Drainage Channel Rehabilitation Work project, Samarinda Ulu District. The data collected is in the form of primary data and secondary data. In accordance with the request from the project owner, the RAB value submitted by the contractor was requested to be reanalyzed. At this stage, the work items that have the highest cost down to the lowest cost will be explained.

Function Analysis

Table 1: Identification of Job Functions

No.	Component	Verb	Noun	B/S	Type	*Cost* (Rp)	*Worth* (Rp)	Information
1	Concrete	Channeling	Burden	B	P	-	-	VE
2	Ironing	Withhold	Burden	B	P	-	-	-
3	Formwork	Withhold	Concrete	S	S	-	-	-
				AMOUNT		-	-	-

The function analysis as table 1 only explains the work items that will be carried out by VE analysis and definitions of the function of measurable verbs and nouns. The value of the benefits (worth) cannot yet be shown at the cost, because it is done at the creative stage (table 2).

Speculation Stage (Creativity)

Table 2. Calculation of Percentage of Work Items

NO.	JOB DESCRIPTION	TOTAL PRICE (Rp)	PERCENT (%)
A	Preparatory work	101.254.900	4,34
B	Earthworks	272.912.010	11,71
C	Concrete Work	1.452.366.184	62,31
D	Piling Work	67.192.500	2,88

E	Iron And Aluminum Works	206.160.250	8,84

Here are some alternatives used in VE for concrete work (table 3):

1. Initial Design (Precast Reinforced Concrete)
2. Partially Precast Reinforced Concrete (Precast)
3. Ready mix cast reinforced concrete

Tabel 3. Value Engineering items alternative

Alternative	Job description	Total Price (Rp)	Difference (Rp)	Comparison (%)
	Initial Design (Precast Reinforced Concrete)	623.679.984		
1	Partially Precast Reinforced Concrete	467.106.327	156.573.657	2,98
2	Ready mix cast reinforced concrete	271.286.436	352.393.548	1,77

The largest value was obtained, the percentage difference was 2.98% in alternative 2 in Partially Precast Reinforced Concrete. From the initial information data, the design is intended for K-300 quality concrete specifications. The 2nd largest comparison was obtained in Ready mix Cast Reinforced Concrete with a comparison value of 1.77%.

Analysis

This stage aims to evaluate whether alternative construction replacement ideas have potential advantages and disadvantages through value engineering. The analysis stage aims to select the best design alternative among various ideas or other design ideas as a proposal in the recommendation stage. As a continuation of the creative stage, this stage focuses on analyzing previously generated ideas or ideas.

The assessment in the analysis stage is carried out as objectively as possible. In this research, the analysis was carried out using the Profit and Loss Analysis method. The alternatives obtained from the creative stage are recorded along with their advantages and disadvantages, then given a weighted value (rating). The selection criteria are determined through discussions with the project party, in this case carried out by the Site Engineering Manager. The assessment of each alternative is also carried out by the Site Engineering Manager (table 4).

The following are details of the steps in the analysis stage:

a) Alternative Identification: Collecting all alternatives generated from the creative stage.
b) Advantages and Losses Assessment: Each alternative is evaluated to identify potential advantages and disadvantages.
c) Giving Weighted Value (Rating): Each gain and loss is given a weight or value based on its importance.
d) Discussion with Project Parties: Assessment criteria and value weights are discussed and agreed with the Site Engineering Manager.
e) Selection of the Best Alternative: Based on the weight of the values given, the alternative with the highest value is selected as the recommended recommendation.

f) By going through this stage, it is hoped that design alternatives can be selected that provide the best value for the project, taking into account all relevant aspects.

Table 4. Analysis of the structure of Drainage Channel Rehabilitation Work

No.	Alternative	Potential Profits	Potential Losses
	Initial Design (Precast Reinforced Concrete)	Produced in factories with special machines and takes less time	Damage can occur during the transportation or moving process
		Consistent Quality	Need adequate equipment
		Ease in terms of greater flexibility in design and application	Costs required for transportation and installation
		Little workforce involvement	need planning in the process of manufacture to transfer
		minimize construction costs	
		Long service life and can be recycled again	
		Environmentally friendly	
1	Partially Precast Reinforced Concrete	Produced in factories with special machines and takes less time	Damage can occur during the transportation or moving process and also at the location
		Consistent Quality	It requires adequate equipment and manpower
		Convenience in terms of greater flexibility in design and application	Costs required for transportation and installation
		Little workforce involvement	need planning in the process of manufacture to transfer
		Faster work	
		minimize construction costs	
		Long service life and can be recycled again	
		Environmentally friendly	
2	Ready mix cast reinforced concrete	Consistent Quality	Lots of workforce involvement
		Speed of Implementation	Cannot be recycled again
		Strict Quality Control	It takes longer in terms of mixing, pouring and drying the concrete
		Time and Energy Efficiency	Limited dimensional accuracy
		Produced and poured at the project site	
		Can be done in narrow areas	
		Work and supervision is more controlled	

		Calculations are relatively easy and common	

Feasibility Analysis

Table 5. Feasibility analysis of Drainage Channel Rehabilitation Work

Drainage Channel Rehabilitation									
No.	Alternative	Criteria					Total	Rank	Choose
		A	B	C	D	E			
1	Partially Precast Reinforced Concrete	2	2	3	2	4	13	2	
2	Ready mix cast reinforced concrete	2	2	4	3	4	14	1	√

In the value feasibility analysis (table 5), there are several basic points that are used as an assessment. The assessment obtained is based on criteria assessed by Relative Weighting.

Relative weighting of Alternative Selection can be seen in table 6:

Table 6. Relative Weighting Results for Alternative Selection in Drainage Channel Rehabilitation Work

No.	Alternative	Criteria					Total	Rank	Choose
		A	B	C	D	E			
		10	8	6	4	2			
1	Partially Precast Reinforced Concrete	2	2	3	2	4	68	2	
		20	16	12	8	8			
2	Ready mix cast reinforced concrete		2	4	3	4	96	1	√
			16	24	12	8			

Function Analysis

Work that has a cost/worth value > 1, then the work can be directly carried out by value engineering. For work that has a cost/worth < 1, a more in-depth study is required before the value engineering process is carried out. From Table 6, the function analysis of reinforced concrete with partial casting shows a cost/worth value of > 1, so this work can be carried out directly by value engineering (table 7).

Table 7. Cost optimization results after VE was carried out on Drainage Channel Rehabilitation Work

NO	JOB DESCRIPTION	PERBANDINGAN		DIFFERENCE
		ENGINEER ESTTIMATE	VALUE ENGINEERING	
		TOTAL PRICE (Rp)	TOTAL PRICE (Rp)	TOTAL PRICE (Rp)

			Alternative 1	Alternative 2	Alternative 1	Alternative 2
1	Concrete Work	623.679.984, 00	467.106.327, 00	271.933.824, 09	156.573.657, 00	352.393.548, 00
	Presentation of work saved with VE (%)		7,46	18,13		

Cost analysis after the work item was carried out by value engineering was obtained by alternative 2 which saved the most costs on concrete work on the Drainage Channel Rehabilitation Work project, namely IDR 352,393,548.00 with the percentage of work saved with VE (%) being 18.13%.

Presentation

The results of Value Engineering on Drainage Channel Rehabilitation Work on concrete work items can be seen in the following table 8:

Table 8. Results of overall cost percentage after VE

NO.	JOB DESCRIPTION	TOTAL PRICE (Rp)	TOTAL PRICE (Rp)
A	Preparatory work	101.254.900	101.254.900
B	Earthworks	272.912.010	272.912.010
C	Concrete Work	1.452.366.184	1.100.620.024
D	Piling Work	67.192.500	67.192.500
E	Iron And Aluminum Works	206.160.250	206.160.250
	TOTAL JOB PRICE	2.099.885.844	1.748.139.684
	PRESENTATION OF SAVINGS		16,78 %

The overall project cost for the initial plan is IDR 2,099,885,844, while the overall project cost after Value Engineering is IDR. 1,748,139,684. The costs saved are IDR 352,393,548.00 or 16.78% of the total project.

CONCLUSION

Based on the results of the research and discussion described in the previous chapter, it can be concluded that:

1. Several alternatives used in VE for concrete work in the Drainage Channel Rehabilitation Work Project, Smarinda Ulu District:
   a. Partially Precast Reinforced Concrete
   b. Ready mix cast reinforced concrete
2. Cost savings obtained from the application of Value Engineering in concrete work are:

a. The cost of concrete work, namely at the beginning or according to plan, is Rp. 623,679,984.00 Costs for concrete work after VE, namely Rp. 271,933,824.09 With costs saved amounting to Rp. 352,393,548.00 or 18.3%.
b. The overall project cost for the initial plan is IDR 2,099,885,844, while the overall project cost after VE is IDR 1,748,139,684. With the cost savings of Rp. Rp. 352,393,548.00 or 16.78% of the total project.

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