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APPLICATION VALUE ENGINEERING ON PROJECT DEVELOPMENT BRIDGE KALITUWUH BLITAR JAVA EAST

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***Abstract* -** *In the construction of a bridge, after calculating the construction of the building, the next step is to make a Budget Plan (RAB). Budget Plan The cost of the bridge construction project is prepared optimally and efficiently while maintaining quality and quality assurance. In this research, it will be studied how the implementation and results of the application of Value Engineering in the work of providing and erecting piles in the Kalituwuh Blitar bridge construction project, East Java. In this thesis assignment, the Value Engineering method was used. After implementing Value Engineering, a proposal was obtained, namely a Bored Pile with a Diameter of 600mm and a Volume of 2342m with a savings value obtained by a comparison of the initial design cost of Rp. 1,610,387,678.72 and the cost of the Value Engineering results is Rp. 608,902,000.00, with this comparison the savings that were successfully obtained from the application of Value Engineering amounted to Rp. 1,001,485,678.72 with a saving percentage of 62%.*

Keywords: Value Engineering, rab, savings.

INTRODUCTION

Projects that require large funds become the center of attention for re-analysis so that savings can be made. This raises various alternatives that can be used as the basis for conducting a study with no intention of correcting errors or improving calculations that have been made by planners but rather looking for cost savings incurred in the project. Therefore, Value Engineering is needed so that unnecessary costs and efforts can be eliminated so that the value or cost of the development project can be reduced. Value Engineering is an approach that has a creative and systematic nature that aims to reduce or eliminate unnecessary costs.

The bridge is one form of infrastructure that is very important in connecting two or more road points. The main function of a bridge is to provide safe and efficient access for vehicles and pedestrians over physical barriers such as rivers, valleys, or roads that cannot be traveled directly.

Bridge construction must be carried out with careful and efficient planning to ensure optimal use of resources. This refers to the concept of Value Engineering (VE), which is a systematic method to increase the functional value of a project by optimizing the use of available resources. Through the application of Value Engineering, the bridge planning and design process can be thoroughly evaluated by considering aspects of cost, safety, structural strength, user needs, the surrounding environment, and other relevant factors. Thus, VE helps identify and eliminate non-value-added activities, reduce construction costs, minimize long-term maintenance, and improve bridge performance and service life.

The use of VE in bridge construction also allows for more efficient design adjustments, such as the use of lighter materials while still meeting structural strength requirements, optimizing bridge geometry to reduce loads on the structure, and applying innovative construction technologies to speed up the construction process. In addition, VE also pays attention to the safety and sustainability aspects of the bridge. In planning the construction of a bridge, the safety aspect of users must be a top priority by considering factors such as road layout, security systems, lighting, and necessary warning signs.

The Kali Tuwuh Bridge (Brongkos - Karangkates Straightening) construction project is located on Jl. Raya Wlingi-Karangkates No. 136, Nambang, Siraman, Kec. Kesamben, Blitar Regency, East Java. This bridge has a very strategic location as a bridge connecting the national road III, where the Kalituwuh bridge connects the Blitar and Malang regions. The bridge, which is located on Jalan R aya Wlingi- Karangkates No. 136, Nambang, Siraman, Kesamben Subdistrict, Blitar Regency, East Java 66191, is a traffic jam that often occurs in the area. This paper will discuss the application of value engineering in the kalituwuh bridge construction project in Blitar, East Java.

RESEARCH METHODS

In the application of Value Engineering, the Value Engineering method or Job Plan technique is used, namely: Information Phase. In the first stage of Value Engineering, the necessary information is collected in the form of: (1) Primary Data is a source of data obtained directly from the original source; (2) Secondary data is data.

Creative Stage. In the creative stage what was done was to change the type of foundation used which previously was a Prestressed Concrete Pile with a diameter of 600 mm replaced with a Bored Pile with a diameter of 600 mm.

Analysis Stage. The analysis is carried out by carrying out profit and loss analysis which aims to get the best alternative idea. Furthermore, a feasibility analysis is carried out using the Zero One method, the steps are: (1) All required criteria are written in the left column and above; (2) A comparison is made between these criteria by comparing one criterion with another. Criteria that have the same weight as the others are marked with an X, the criterion that is lacking important is given a value of 0, criteria that are more important than the others are given a value of 1. These values are added up, the largest is the highest rank, and the results of the analysis are given a weight.

Development Stage. After knowing the total cost for each alternative, an assessment is carried out to determine the weight of a number of test parameters for each criterion: (1) Cost focuses on the costs involved in the pile work; (2) Time. Is the time used in carrying out the work of the pile. Quality Control. Emphasis is placed on the quality of the pile material used. In this case the initial designs and designs that have been in VE, have good quality.

Recommendation Stage. At this stage there are three things that must be done, namely: (1) Examine all proposed alternative solutions carefully and in detail to select those alternative solutions that have high value and significant savings; (2) Proposals for project management must be well made and accurate; (3) Represents a plan to implement.

Table 1. Alternate design analysis

No.	SubWorkPoleStake	Cost
1.	Provision Pole Stake Concrete Prestressed Precast diameter 600mm	1,278,732,000.00
2.	Erection Pile Concrete Prestressed Precast Diameter 600 mm	331,655,678.72
3	Load Testing Dynamic PDLT (PileDynamic Load Testing) on Pole size/diameter 600 mm	100,000,000.00
	Amount	1,710,387,678.72

Alternative 1 pole bored pile. Bored pile foundation is a type of deep foundation that is shaped like an elongated tube consisting of a mixture of reinforced iron and concrete with certain dimensions and diameters that are installedin the ground.

Alternative 2 Spun Pile. After analyzing the RAB data (Budget Plan) for the Kalituwuh Blitar Bridge project, it was found that the Piling Work Cost was Rp. 1,710,387,678.72. With the pile sub-work, namely the provision of precast prestressed concrete piles with a diameter of 600mm which costs Rp. 1,278,732,000.00, the erection of precast prestressed concrete piles with a diameter of 600mm which cost Rp. 331,655,678.72.

RESULTS AND DISCUSSIONS

The Cost Budget Plan (CBP) data is a document that presents in detail the estimated costs required in bridge construction. CBP data includes various cost items such as excavation, foundation, superstructure, bridge installation, safety equipment, and various other relevant components. CBP data is compiled by considering the design and technical specifications that have been made previously. By having accurate CBP data, related parties can conduct financial evaluations, resource planning, and supervision of bridge construction projects. CBP data is also a guideline in material procurement, construction bidding, and controlling the cost and time of project implementation. Thus, the preparation of the CBP Data is an important step in the process of planning and budgeting for efficient and appropriate bridge construction. Cost Budget Plan Data as in the following table.

Table 2. Cost of pile work

No	Type	Diameter	Volume	PriceUnit	Amount
1	Alternative1PoleboredPiles				
	procurementpole	600mm	2342	260,000.00	608,920,000.00
	Amount				608,920,000.00
2	Alternative2PoleStakespunpiles				
	ProvisionPole	600mm	2342	1,269,728.36	2,973,703,819.12
	Amount				2,973,703,819.12

In terms of cost, the alternative design of 1 Bored Pile costs Rp. 608,920,000.00 with a pile diameter of 600mm and a pile volume of 2,342 m^3. While the alternative design of 2 Spun Pile Poles costs Rp. 2,973,703,819.12 with a pile diameter of 600mm and a pile volume of 2,342m^3 for the pile work.

Table 3. Profit and loss analysis Table

Project :DevelopmentBridgeKalituwuhItems :PoleStake Function :support				
StageAnalysis		StageSpeculation		
		DesignBeginning	Alternative1	Alternative2
Cost	Profit		Cheap	
	Make a loss	Expensive		Expensive
Quality	Profit	Good	Good	Good
	Make a loss			
Time	Profit	Fast		Fast
	Make a loss		Long	
executor	Profit	Easy	Easy	Easy
	Make a loss			

Then a Profit and Loss Analysis is carried out with several aspects that are seen including Cost, Time, Quality, and Implementation. The initial design for the Kalituwwuh Bridge Construction project cost Rp. 1,610,387,678.72 which can be categorized as "expensive", as well as alternative design 2 which costs Rp. 2,973,703,819.12 can also be categorized as "expensive", whereas alternative 1 costs Rp. 608,920,000.00 can be categorized as "cheap. In terms of the initial design time the piles take 16 days which can be categorized as "fast", as well as the alternative 2 piles which take 16 days which can be categorized as "fast". While the alternative 1 piling takes 41 days which can be categorized as "long". In terms of quality, all pile designs have the same quality and can be categorized as "good". Likewise in terms of implementation, all pile designs can be categorized as "easy". Design alternative development stage The cost is calculated, then differentiated.

Table 4. Analysis of alternative pile costs

No	Type	Diameter	Volume	PriceUnit	Amount
1	DesignBeginningPoleStakeConcretePrestressedPrecast				
	ProvisionPole	600mm	2342	546,000.00	1,278,732,000.00
	ErectionPole	600mm	2342	141,612.16	331,655,678.72
	Amount				1,610,387,678.72
2	Alternative1PoleboredPiles				
	procurementpole	600mm	2342	260,000.00	608,920,000.00
	Amount				608,920,000.00
3	Alternative2 PolesStakespunpiles				
	ProvisionPole	600mm	2342	1,269,728.36	2,973,703,819.12
	Amount				2,973,703,819.12

Alternative design costs to the initial design of the project. Here the loading test value is Rp. 100,000,000 not included. So, the piles that are included are the provider's value and just the driving. The initial design of precast prestressed concrete piles cost Rp. 1,610,387,678.72, alternative 1 pile using bored piles spends funds in the amount of Rp. 608,920,000.00, an alternative of 2 piles using spun piles costs Rp. 2,973,703,819.12. Then proceed with matrix analysis, in the matrix analysis test it is taken to evaluate the score with the following parameters:

Table 5. Matrix criteria

J	Cost	Quality	Time	Implementation	Total	Rank
Weight	10	9	8	7		
DesignBeginningPoleConcrete PilesPrestressedPrecast	3	3	4	3		2
	30	27	32	21	110	
Alternative1PoleboredPiles	4	4	2	3		1
	40	36	16	21	113	
Alternative2PoleStakespunpiles	1	4	3	3		3

The above evaluation parameters, namely cost, quality, time, and execution, will be multiplied by their respective weights to obtain comprehensive matrix analysis results. In this process, the parameter weights can be set based on the priority and relative importance of each parameter.

The cost parameter, which has a weight of 10, indicates the importance of evaluating the financial aspects of the project. Efficient transfer of funds and good cost control are the main focus in assessing alternative solutions. The quality parameter, weighted 9, illustrates the need to ensure proper standards and specifications in the project. Quality evaluation includes performance, durability, safety, and compliance with applicable regulations and technical requirements. The time parameter, weighted 8, focuses on the speed of project implementation. Assessment of time includes duration estimation, efficient scheduling, and the ability to complete the project within the set targets. The implementation parameter, weighted 7, reflects the ability to manage and supervise the overall project implementation. This aspect involves team coordination, selection of contractors or implementing parties, and management's ability to cope with risks and changes that may occur.

Table 6. Matrix analysis

No	Criteria	ParameterTester	Score
1	Cost	Rp600millionuntilIDR 1.2M	4
		Rp1.2MuntilRp1,8M	3
		Rp1,8MuntilRp2,4M	2
		Rp2,4MuntilRp3M	1
2	Quality	VeryGood	4
		Good	3
		NoGood	2
		VeryBad	1
3	Time	Fast	4
		Currently	3
		Slow	2
		VerySlow	1
4	Implementation	Very easy	4
		Easy	3
		Difficult	2
		VeryDifficult	1

By multiplying the value of these parameters with their respective weights, a matrix analysis result will be obtained that describes the relative score of each alternative solution. This score can be used as the basis for decision-making to choose the most optimal solution.

The proposal stage or implementation stage is the final stage in the Value Engineering Method. At this stage, the results of the matrix analysis are used as a basis for developing proposals or recommendations for solutions that are considered the best. The proposal will involve selecting the alternative solution that has the highest score in the matrix analysis, taking into account resource availability, regulatory compliance, and other relevant factors.

In the implementation stage, the selected solution will be put into action by organizing action plans, monitoring project progress, and conducting evaluations to ensure the achievement of the set objectives. This stage marks the completion of the Value Engineering Method and is the beginning of the implementation of the recommended solution.

CONCLUSIONS

Based on the results of the application of Value Engineering to the Pile Work of the Kalituwuh Blitar Bridge Construction Project using the Bored Pile method, there are several conclusions that can be drawn: The value of savings achieved through the application of Value Engineering is significant. There was a comparison between the initial design cost of Rp. 1,610,387,678.72 and the Value Engineering result cost of Rp. 608,902,000.00. This shows that the application of Value Engineering succeeded in reducing the cost by Rp. 1,001,485,678.72. The savings achieved reached a high percentage of 62%. This percentage illustrates how much cost reduction was achieved through Value Engineering. With these savings, the bridge construction project can allocate resources and budget more efficiently. This conclusion shows that the application of Value Engineering in the Kalituwuh Blitar Bridge Construction project using the Bored Pile method provides significant results in cost reduction. The savings achieved provided significant financial benefits to the project. Thus, the application of Value Engineering is an effective strategy in optimizing the use of resources and budgets in construction projects.

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