Optimization of Construction Costs Through Budget Plan Review

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Abstract. A project's implementation costs are one of the most important elements in deciding if a construction project will succeed. The Project execution frequently encounters issues like ineffective material utilization, inept personnel, and improper work method selection. These problems may cause projects to be completed more slowly and more expensively than planned. Project cost control can be used to lessen these issues. Value engineering analysis is the research methodology used. Value engineering is used to optimize project expenses by locating and eliminating superfluous costs. This study aims to maximize building project efficiency in terms of money, time, technology, and creativity. Price surveys are the principal means of data collecting in this descriptive-quantitative study design. Project managers and suppliers of materials are among the respondents. The Unit Price Analysis and the Budget Plan are examples of the secondary data that was employed. The best alternative design and the least expensive alternative design are divided into two categories based on the analysis results. The cheapest alternative's cost optimization is 9.95%, or IDR 1,336,499,405, of the initial design cost, whereas the best alternative's cost optimization is 9.14%, or IDR 1,222,120,406.

Keywords: Cost, Engineering, Optimization, Value

1 Introduction

The cost of project implementation is one of the most critical factors in determining the success of a construction project. In a construction project, the project cost is influenced by many factors, such as material selection, work methods, and design. However, during the execution, a project often encounters issues such as inefficient materials, incompetent resources, and improper work methods, according to (Diputera et al., 2018). According to (Usboko et al., 2024), these issues can result in the project taking much more time and money. This can be mitigated by implementing project cost control. Project cost control is one solution for managing project costs that have escalated from the initial plan, according to (Kartohardjono, 2017). According to (Pratiwi, 2014), one cost control method that can be implemented is value engineering. Value engineering is a structured and innovative cost control method. The purpose of value engineering, according to (Hasan Busri, 2014), is to identify and eliminate unnecessary costs, making the project cost more optimal. Additionally, according to (Amelia & Sulistio, 2019), value engineering not only optimizes project costs but also identifies alternatives without compromising the quality and function of

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the work. Research on value engineering has been widely conducted, such as by (Dinariana et al., 2021), who studied the value engineering of architectural work in the planning of the Navalunit building in West Papua. This study concluded that efficiency gains based on selected alternative recommendations were 7.7% for architectural work and 2.6% for the overall work. The application of value engineering to architectural work in the Transmart Carrefour Padang development project achieved a cost saving of IDR 1,797,509,359 from the total architectural work cost of IDR 62,837,567,773, according to (Khaerul Bahri & Retno Indryani, 2018). (Nandito et al., 2020) found that applying value engineering to the Puskesmas Rego construction project in West Manggarai, NTT, resulted in a saving of IDR 541,296,385, or 3.4% of the initial design cost. Additionally, (Santoso, 2020) found that applying value engineering to the building structure of the Fire Department Office in Surakarta yielded a cost saving of IDR 481,581,732.41. Based on these studies, it can be hypothesized that implementing value engineering in budget planning can optimize project implementation costs. Sumitra Hotel and Resort is a hotel and villa construction project by contractor PT. Tunas Jaya Sanur. Sumitra Hotel and Resort consists of 4 hotel blocks and 7 villa units. During its execution, this project experienced an overbudget situation from the initial budget plan. This was caused by inappropriate work methods and unskilled human resources, leading to delays in the overall project implementation. If not addressed promptly, this could result in significant financial losses for the project. From the background provided, a value engineering analysis can be conducted on the Sumitra Hotel and Resort project. The purpose of the value engineering analysis is to find more economical alternatives, thereby optimizing the project implementation costs. This study performs value engineering through several stages: collecting data in the form of the project budget (RAB), followed by a function analysis using the F.A.S.T. diagram method, and then a creativity phase to seek alternatives. The selected alternatives are then calculated to determine the most economical implementation costs and the amount of cost optimization achieved. The success of construction projects is often jeopardized by rising costs due to inefficient materials, poor resource management, and inappropriate work methods. Value engineering (VE) has emerged as a critical solution, offering a structured approach to cost control while maintaining project quality. Studies have demonstrated significant cost savings through VE in various projects, such as the Transmart Carrefour Padang development and the Puskesmas Rego construction, yielding savings of up to 7.7% and 3.4%, respectively. By implementing VE techniques like function analysis and creativity phases, the Sumitra Hotel and Resort project aims to address budget overruns caused by inefficient practices. This study seeks to explore alternative solutions to optimize project costs without compromising quality, demonstrating the potential of VE to significantly enhance financial outcomes in construction.

2 Methodology

This research uses a descriptive quantitative research method, which involves problem-solving by describing, investigating, and explaining the subject as it is and drawing conclusions from observable phenomena using numerical data (Sulistyawati et al., 2022). The data collection method used includes gathering primary data through field observations and interviews with the Project Manager of Sumitra Hotel and Resort regarding execution methods. High-cost work items are identified and followed by a FAST analysis to obtain design alternatives. The next phase is the development stage, where the best alternative options are compared and developed, followed by the presentation stage, which involves cost optimization. In this research, the object of study is the implementation cost of the Sumitra Hotel and Resort project. This implementation cost is analyzed using value engineering with specified criteria and alternatives. The obtained design alternatives are more cost-competitive options. Briefly, the stages involved in conducting this research are as follows: identifying the issues to be researched involves determining which tasks at the Sumitra Hotel and Resort project can undergo Value Engineering and estimating the cost optimization achievable through the selected Value Engineering alternatives. The objectives of this research aim to determine which tasks can undergo Value Engineering and estimate potential cost savings achievable through the application of Value Engineering in the execution of the Sumitra Hotel and Resort project. Conducting a literature review involves studying previous research, journals, papers, articles, and online media. Gathering primary data involves collecting price survey results, and secondary data includes information related to existing designs and project details (such as RAB and AHSP), to support the Value Engineering analysis of the Sumitra Hotel and Resort project by the project contractor. Performing functional analysis on the gathered information involves determining desired functions that achieve the lowest cost to identify primary functions, supporting functions, and identifying values that can be eliminated. The creative phase involves generating alternative design ideas to compare with the existing design. The more ideas generated, the more comparative alternatives emerge as solutions. The evaluation phase involves selecting the appropriate alternative from all available options. The presentation phase entails reporting the results of the analysis, including the extent of cost savings achieved.

3 Result and Discussion

3.1 Result

In the Value Engineering analysis, the initial step involves measuring the dominant parameter values. This diagram assists in categorizing work items that fall within the criteria with accumulated costs amounting to 80% of the total project cost. These categorized work items then undergo functional analysis as part of the Value Engineering process. In the Sumitra Hotel Phase H project, work items have been ranked based on their percentage contribution to the total cost, from highest to lowest. The Pareto diagram illustrates the work items meeting the 80% accumulated cost criteria, as shown in the table and figure.

Table 1. The highest to lowest percentage of work values

No.	Works items	Total price (IDR)	%	Cum
1	Concrete work	7,343,622,613	23%	23%
2	Air Conditioning Work	6,154,076,691	19%	42%
3	Door And Window	3,310,368,800	10%	52%
4	Plumbing Work	2,949,289,930	9%	61%
5	Electrical Works	2,379,554,802	7%	68%
6	Wall works	1,739,875,396	5%	74%
7	Electronic Works	1,098,131,307	3%	77%
8	Roof works	1,086,538,102	3%	80%
9	Foundation works	994,660,754	3%	83%
10	Walls finishing	926,934,188	3%	86%
11	Miscellaneous Work	867,391,810	3%	89%
12	Lift Work	786,049,705	2%	91%
13	Floor Finishing	648,771,502	2%	93%
14	Fire Fighting Work	594,115,246	2%	95%
15	Groundwork	496,488,890	2%	97%
16	Swimming Pool	489,699,773	2%	98%
17	Cable Tray And LadderWork	351,919,024	1%	99%
18	Ceiling Finishing	246,056,249	1%	100%
	Total	32,463,544,782	100 %	

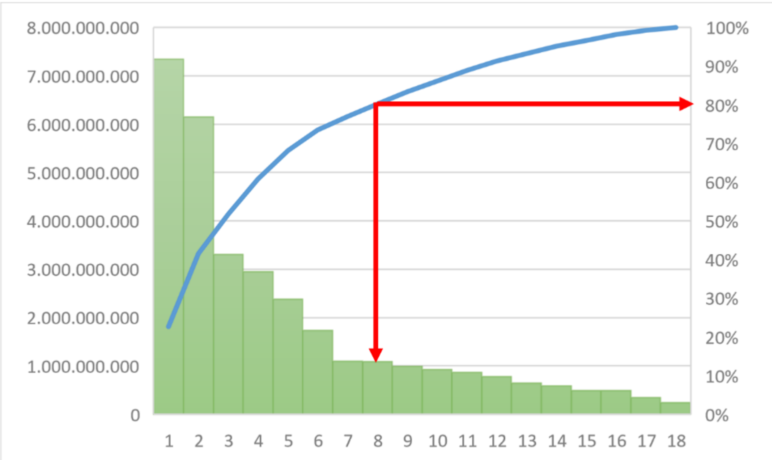

Figure 1. The Pareto chart of all work items

After identifying the work items that fall within the criteria of 80% cumulative cost for Value Engineering analysis, the next steps involve functional analysis and creativity, aligning with the criteria obtained from the information phase, The criteria used in this Value Engineering analysis include:

Table 2. Value engineering criteria

No.	Works items	Criteria
1	Concrete work	Waste material Material efficiency Technological innovation Cleanliness level Execution time Material mobilization Strength quality
2	Air conditioning work	Technological innovation Execution time Ease of Installation
3	Door and window	Cost Termite resistance Water and moisture resistance Rust resistance Expansion and shrinkage resistance Technological innovation Maintenance Ease of installation Execution time Material weight Aesthetics
4	Plumbing work	Working principle Energy storage Reliability and work cycle Maintenance Noise
5	Electrical works	Cost Technological innovation Maintenance Ease of installation Execution time
6	Wall works	Soundproofing Waterproofing Fire resistance Technological innovation Execution time Maintenance
7	Electronic works	Cost Technological innovation Maintenance Ease of Installation Execution time
8	Roof works	Cost Technological innovation Maintenance Ease of installation Execution time

After determining alternatives based on the criteria, the next step involves evaluating the selected alternatives, Since the research objective is to optimize implementation costs, the evaluation will focus on cost considerations in line with the given criteria, Based on the evaluation results of alternative designs, the best alternative was identified to replace the original design, The combination of the best alternative designs is a blend of alternatives that scored highest in the comprehensive evaluation stage, where these alternatives were compared with the original design considering cost, quality, and project timeline for each design element reviewed, The specific combination can be seen in Figure 2.

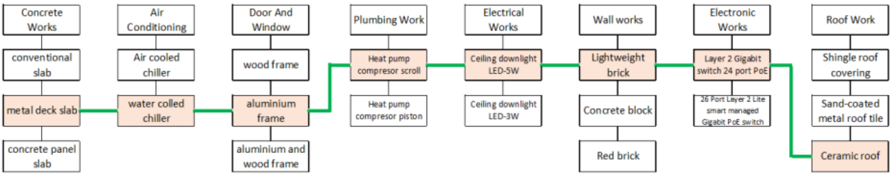

Figure 2. The best alternative designs

In addition, after determining the best combination of alternatives based on comparison criteria, the cost optimization can be calculated, The initial implementation cost for the selected work items is IDR 13,372,118,306, With the best alternative combination, the cost savings achieved amount to 9.14% or IDR 1,222,120,406 from the initial design cost, If the selection of alternative combinations is based on the lowest price to achieve cost optimization, it will yield the cheapest alternative combination as shown in Figure 3.

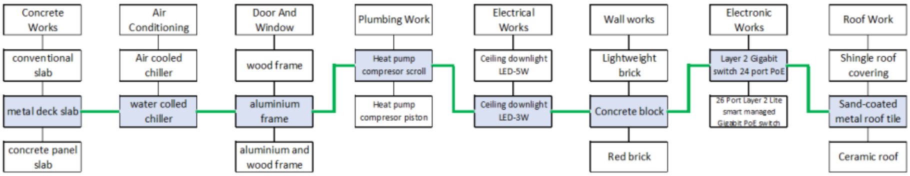

Figure 3. The cheapest alternative designs

Based on the cheapest alternative combination, cost optimization for implementation amounts to IDR 1,336,449,405 or 9.95% of the initial design budget.

3.2 Discussion

Based on the analysis conducted, significant results have been obtained, The analysis results are in line with similar previous research findings, The application of Value Engineering can effectively reduce project implementation costs, Based on the analysis results, it is also recommended that the best time to apply Value Engineering is during the planning phase.

4 Conclusion

Based on the analysis results, the following conclusions can be drawn: The selected Alternative Designs for each work item are grouped into two categories: the best alternative and the most cost-effective alternative, detailed as follows:

The best alternative designs include: conventional floor slab work changed to metal deck floor slab, air-cooled chiller HVAC work changed to water-cooled chiller, doors and windows using wooden frames changed to aluminum frames and panels, plumbing work using a scroll heat pump compressor remains unchanged, electrical work using LED-5W ceiling downlights remains unchanged, wall work using lightweight bricks remains unchanged, electronic work using Layer 2 Gigabit switch 24 port PoE remains unchanged, and roof work using shingle roofing changed to ceramic tile roofing.

The cheapest alternative designs include: conventional floor slab work changed to metal deck floor slab, air-cooled chiller HVAC work changed to water-cooled chiller, doors and windows using wooden frames changed to aluminum frames and panels, plumbing work using a scroll heat pump compressor remains unchanged, electrical work using LED-5W ceiling downlights changed to LED-3W ceiling downlights, wall work using lightweight bricks changed to concrete blocks, electronic work using Layer 2 Gigabit switch 24 port PoE remains unchanged, and roof work using shingle roofing changed to sand-coated metal tiles.

The amount of cost optimization obtained based on the selected alternative designs is as follows: Cost optimization for the best alternative is 9.14% or IDR 1,222,120,406 from the initial design cost, Cost optimization for the cheapest alternative is IDR 1,336,499,405 or 9.95% of the initial design cost.

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