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Value Engineering on the Mosque Construction Project in the South Kalimantan Provincial Government Office Area

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Abstract: The analysis performed to optimize costs will generate alternatives that will be compared with the initial design, and this analysis can be called value engineering analysis. This research aims to assess the percentage of cost savings that can be obtained by applying the value engineering technique, as well as to evaluate the life cycle cost of various selected material alternatives. The Mosque Construction Project in the South Kalimantan Provincial Government Office Area was chosen as the research object because of cost inefficiency in the architectural work, with a total cost of Rp. 26,857,215,362.63 out of the total project cost of Rp. 55,600,738,764.97. The architectural work will be corrected using Pareto diagram analysis through the value engineering phases, namely the information phase, speculation phase, and analysis phase. From the value engineering analysis results, a savings of 3.65% of the total project value was obtained. The life cycle cost analysis shows that the selected material has a lower life cycle cost value compared to the initially planned material. In addition, the work execution time with the selected material can complete the work on site more quickly.

Keywords: Value Engineering, life cycle cost

INTRODUCTION

In the era of significant global economic development, many aspects of life are affected, one of which is the development sector. The construction sector in Indonesia has an increasingly crucial economic value every year, resulting in various projects such as buildings, roads, houses, and industrial structures. These development projects are carried out due to the increasing needs of the community and companies in Indonesia. With the high demand for buildings, the construction sector is required to carry out activities that are effective and efficient, and to save construction costs without compromising quality and work duration. The analysis performed to optimize costs will generate alternatives that will be compared with the initial design, and this analysis can be called value engineering analysis. The benefit of value engineering analysis is a systematic and planned approach to increase the functional value or utility of a project, without ignoring factors of appearance, quality, and maintenance.

This research will analyze value engineering on the architectural work of the Mosque Construction Project in the South Kalimantan Provincial Government Office Area. This architectural work was chosen as the research object due to a request from the Project Owner, namely the Cipta Karya Division of the South Kalimantan Provincial Public Works and Public Housing Agency, which was conveyed in a Weekly Meeting on February 6, 2024. In the meeting, it was indicated that there was an ineffective cost in the architectural work amounting to Rp. 26,857,215,362.6285 out of the total project cost of Rp. 55,600,738,764.9676. This work cost will be corrected using the Pareto diagram analysis and the value engineering phases, which include the information phase, speculation phase, and analysis phase. In the analysis phase, an analysis of the advantages and disadvantages of each alternative will be carried out, as well as the determination of alternatives using the Simple Additive Weighting (SAW) method based on the results of questionnaire distribution. The next phase is the development phase, which analyzes the life cycle cost, and the final phase is the presentation phase.

This research aims to optimize the cost, time, and function of the work in the Mosque Construction Project in the South Kalimantan Provincial Government Office Area. The results of this study will show the percentage of cost savings and the duration of the architectural work resulting from the value engineering process, and also analyze the life cycle cost of the selected material alternatives.

METHODS

Research design can be defined as a strategy to organize the background so that researchers can obtain valid data in accordance with the characteristics of the variables and the research objectives. The analysis used in this study is the quantitative research method, which is based on the philosophy of positivism. Data analysis is quantitative or measurable, with the aim of testing previously established hypotheses. The object of this research is the Mosque Construction Project in the South Kalimantan Provincial Government Office Area.

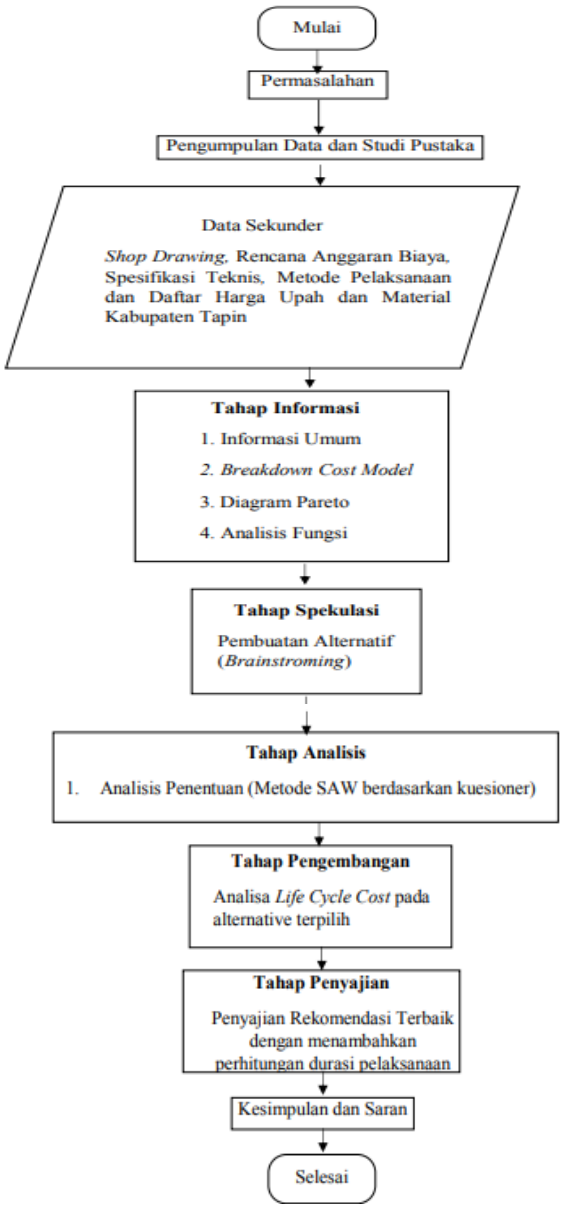

Figure 1. Research Flow Chart

The analysis uses the Pareto Distribution Law Approach to identify job item components in a project that have a large cost and influence the overall total project cost. Within these high-cost job items, there is a large potential for savings if analyzed more deeply using value engineering. The research steps follow a flowchart that includes the Information Phase, Speculation Phase, Analysis Phase (SAW Method based on questionnaire), Development Phase (Life Cycle Cost analysis), and Presentation Phase (Recommendations).

RESULT AND DISCUSSION

Information Phase

The initial step in the value engineering analysis process is the information stage. At this stage, information is gathered about the project that will be subjected to value engineering analysis. Based on general project information related to project implementation costs, a value engineering feasibility analysis will be conducted on the architectural work, along with a Pareto diagram analysis, and finally, a functional analysis.

General Information

This mosque construction project in the South Kalimantan Provincial Government office complex will function as a place of worship for Muslims living near the South Kalimantan Provincial Government office complex. The total construction cost of this project is Rp 55,600,738,765. The architectural work will be analyzed using value engineering analysis to reduce the implementation costs, which, as shown in the data above, amount to Rp 11,311,556,662. Following this, a feasibility test for the value engineering analysis will be conducted on the architectural work using a Pareto diagram analysis and a functional analysis.

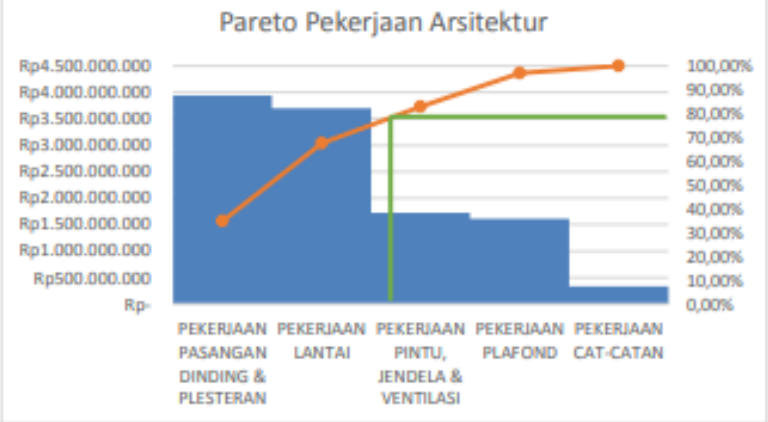

Figure 2. Feasibility Test of Architectural Work Using Pareto Diagram Analysis

The work that will be subjected to value engineering analysis is work that contributes approximately 20% of the total cost of architectural work, which is the largest cost of the entire project. Work included in the 20% percentage is the work of ceramic walls on the inside using granite, lightweight brick wall installation t.10 cm, and plastering work 1SP: 4 PP 15 mm thick. Work included in the 20% percentage is the work of granite installation 60 x 120 (A1), granite installation 60 x 60 (A3), granite installation 60 x 60 (A7), and granite installation 20 x120 (A7) outside area. Work included in the 20% percentage is the work of the main teak wood door, type P6 door, type J1 window, and type P2 door.

Feasibility Test of Architectural Work with Functional Analysis

From the analysis of the work functions of wall and plastering, flooring, and door, window, and ventilation, it was found that the cost-to-worth ratio was more than 1, in accordance with the provisions of ASTM E-1699 (2010) regulations. This indicates that these work items have significant savings potential when analyzed using the value engineering method. One of the work items included in the cost-to-worth ratio is the work on the interior walls of the mosque covered with 60x60 granite, equivalent to Nitro. Furthermore, from the analysis of the floor work function, it was found that the granite masonry work (A1), granite masonry work (A3), and granite masonry work (A7) fell into the category of cost-to-worth ratio values exceeding 1. This indicates that these works have significant savings potential when subjected to value engineering analysis. Meanwhile, from the analysis of the door, window, and ventilation work functions, no work was found that had a cost-to-worth ratio value of more than 1. This indicates that the costs of the door and window work were optimal.

Speculation Stage

In this speculative stage, efforts will be developed to introduce innovation in developing the functional value of value engineering work by creating alternatives that can be used in the primary function of the building. Developing alternative ideas requires information from literature studies and the experience of field practitioners. The practitioners interviewed in this study are Bachelor of Architecture Engineering graduates with approximately five years of experience working with contractors and construction management consultants.

For wall and plastering work, the cost-to-worth ratio includes the interior walls covered with 60x60 Niro-style granite. Alternative 1: 50x50 ex-HABITAT Merchia (Glossy) ceramic tiles. Alternative 2: 30x60 Thomson Series Brown ceramic tiles.

For flooring work, the cost-to-worth ratio includes the granite tiles (A1) in the main section of the mosque, the granite tiles (A3) in the ablution area, and the granite tiles (A7) in the mosque corridors. Alternative 1: Merbau Wood Parquet, Alternative 2: 60x60 ex-Milan Ceramic Tile Habitat Carrara Silver.

Analysis Stage

The results of the previous brainstorming session will be followed by an analysis phase to evaluate the generated alternatives. This analysis process will involve interviews with practitioners with expertise in the architectural field.

Following the interviews, the scores for each alternative will be ranked based on a calculation by multiplying the normalized score by the importance score assigned to each assessment criterion. This multiplication yields the following results: the initial material score is 0.722, alternative 1 is 0.850, and alternative 2 is 0.894. After the evaluation, alternative 2 (30 x 60 Thomson Series Brown ceramic tile) was selected because it had the highest score from the interviews.

After conducting the interviews, the scores for each alternative were ranked based on a calculation by multiplying the normalized score by the importance score assigned to each assessment criterion. This multiplication yielded the following results: the initial material score was 0.738, alternative 1 score was 0.782, and alternative 2 score was 0.810. After the evaluation, alternative 2 (ex Milan Ceramic Tile Habitat 60x60 Carrara Silver) was selected as the material with the highest score based on the interviews.

Based on the interviews, the normalized scores for each alternative were ranked by multiplying the normalized score by the importance score assigned to each assessment criterion. This calculation showed that the initial material score was 0.735, alternative 1 score was 0.880, and alternative 2 score was 0.887. Based on these results, the alternative with the highest score was selected, namely alternative 2 (Impresso Rocky Black 30x30 Ceramic), which was selected based on the interviews.

Based on the interview results, the normalization value for each alternative will be sorted by multiplying the normalization value by the importance value given for each assessment criteria. The results of this calculation show that the initial material value is 0.757, the value of alternative 1 is 0.875, and the value of alternative 2 is 0.787. From these results, the alternative with the highest value is selected, namely alternative material 1 (Habitat Gress Keramik Gol. 2 Formigo Nero 30x60), which was selected from the results of the interviews that were distributed.

Development Phase

In this development phase, a cost savings analysis and a life cycle cost analysis will be conducted on the projects analyzed using value engineering.

a. After calculating the Unit Price Analysis for Alternative 2 (30x60 Thomson Series Brown Ceramic Tile), the cost savings are 12.32% of the initial cost.
b. After calculating the Unit Price Analysis for Alternative 2 (ex Milan Ceramic Tile Habitat 60x60 Carrara Silver Ceramic Tile), the cost savings are 81.18% of the initial cost.
c. After calculating the Unit Price Analysis for Alternative 2 (30x30 Impresso Rocky Black Ceramic Tile), the cost savings are 50.04% of the initial cost.
d. After calculating the Unit Price Analysis of alternative 1 (Habitat Gress Ceramic Class. 2 Formigo Nero 30x60), the cost savings percentage was 21.42% of the initial cost.

The analyzed Life Cycle Cost values indicate that the work using the selected alternative resulting from the value engineering analysis is less valuable than the work using the initial material design. This is due to lower maintenance costs for the selected alternative material, as it does not require polishing costs in accordance with existing regulations.

The analyzed Life Cycle Cost values indicate that the work using the selected alternatives resulting from the value engineering analysis has a lower cost compared to the work using the initial material design. This is due to lower maintenance costs, as the selected alternative materials do not require polishing costs in accordance with existing regulations. The following are the results of Life Cycle Cost calculations for various jobs:

a. Interior Granite Masonry Work:

   Initial Cost:

   - Construction Cost (Item Cost) of Initial Design: Rp. 1,389,496,935.46

   - Construction Cost (Item Cost) of Selected Alternative: Rp. 1,218,241,886.40

b. 60x120 Granite Masonry Work (A1):

   Initial Cost:

   - Construction Cost (Item Cost) of Initial Design: Rp. 1,943,643,620.46

   - Construction Cost (Item Cost) of Selected Alternative: Rp. 365,726,240.00

c. 60x60 Granite Masonry Work (A3):

   Initial Cost:

   - Construction Cost (Item Cost) of Initial Design: Rp. 414,673,013.33

   - Construction Cost (Item Cost) of Selected Alternative: Rp. 207,155,902.80

Presentation Phase

In this phase, all value engineering analysis results will be presented concisely, along with supporting data from the previous phases. It is hoped that these analysis results will provide input to the project owner.

Table 1. Results of Alternative Changes to Value Engineered Work

No	Item Pekerjaan	Biaya Sebelum VE	Biaya Sesudah VE	Prosentase Penghematan
1	Dinding bagian dalam 80asjid dilapis granit 60 x 60 setara Niro	Rp 1,389,496,935.46	Rp 1,218,241,886.40	12.32%
2	Pas.granit 60 x 120 setara Niro granite Travertine (A1)	Rp 1,943,643,620.46	Rp 365,726,240.00	81.18%
3	Pas.granit 60 x 60 setara Niro granite Murale (A3)	Rp 414,673,013.33	Rp 207,155,902.80	50.04%
4	Pas.granit 60 x 60 setara Niro granite cementum (A7) Area Dalam	Rp 335,126,557.58	Rp 263,337,307.20	21.42%

Selected Alternative Job Duration

The duration of the work is calculated using worker productivity, derived from the mason's coefficient in the calculated Unit Price Analysis. The interior walls of the mosque are covered with 60x60 granite, equivalent to Niro (Selected Alternative).

Job Duration = Work Volume/(Productivity of 1 Craftsman x Number of Craftsmen)

= 2694/(2.86 x 30) = 31.43 days

= 32 days

60 x 120 Granite Masonry Work Equivalent to Niro Granite Travertine (A1) (Selected Alternative)

Job Duration = Work Volume/(Productivity of 1 Craftsman x Number of Craftsmen)

= 800/(8.33 x 10)

= 9.6 days = 10 days

60 x 60 Granite Masonry Work Equivalent to Niro Granite Murale (A3) (Selected Alternative)

Job Duration = Work Volume/(Productivity of 1 Craftsman x Number of Craftsmen)

= 658/(2.86 x 15)

= 15.35 days = 16 days

60 x 60 Granite Masonry Work Equivalent to Niro Granite Cementum (A7) (Selected Alternative)

Job Duration = Work Volume/(Productivity of 1 Worker x Number of Workers)

= 522/(2.86 x 15)

= 12.18 days = 13 days

CONCLUSION

Based on the analysis that has been done in this research, it can be concluded as follows: first, the savings that occurred after the Value Engineering analysis on the work of the Inner Wall of the Mosque Coated with Granite 60x60 equivalent to Niro is Rp. 171,255,049, with a percentage of 12.32%.

Second, Savings on Granite Pairing Work 60x120 (A1) is Rp. 1,577,917,380, with a percentage of 81.18%. Third, Savings on Granite Pairing Work 60x60 (A3) is Rp. 207,517,110, with a percentage of 50.04%. Fourth, Savings on Granite Pairing Work 60x60 (A7) is Rp. 71,789,250, with a percentage of 21.42%. If the amount of savings from each job is accumulated, the total savings achieved is Rp. 2,028,478,790, or equivalent to 3.65% of the total project value.

The Life Cycle Cost value that has been analyzed indicates that the work with the selected alternative results from the value engineering analysis has a smaller value than the initial material design work because in maintenance costs, the selected alternative material does not require costs for polishing in accordance with existing regulations. The following are the results of the life cycle cost calculation on: a. Interior Wall Granite Pair Work, Initial Cost (Initial Cost) Construction Cost (Item Cost) Initial Design = Rp. 1,389,496,935.46 and Construction Cost (Item Cost) Selected Alternative Rp. 1,218,241,886.40. b. The following are the results of the life cycle cost calculation on the 60x120 Granite Pair work (A1) Initial Cost includes Construction Cost (Item Cost) Initial Design = Rp. 1,943,643,620.46 Construction Cost (Item Cost) Selected Alternative = Rp. 365,726,240.00. c. For 60x60 (A3) Granite Masonry Work for Initial Design Construction Cost (Item Cost) = Rp. 414,673,013.33 Selected Alternative Construction Cost (Item Cost) = Rp. 207,155,902.80.

The duration of work on the selected alternative materials was obtained on the Inner Wall of the Mosque Coated with 60x60 Granite equivalent to Niro for 32 days with the number of masons working as many as 30 people. %. On the 60x120 Granite Pairing Work (A1) for 10 days with the number of masons working as many as 10 people. On the 60x60 Granite Pairing Work (A3) for 16 days with the number of masons working as many as 15 people. And finally on the 60x60 Granite Pairing Work (A7) for 13 days with the number of masons working as many as 15 people.

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