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**Research Paper**

# Value Engineering of Architectural Work in Navalunit Building Planning,in West Papua

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***ABSTRACT***
*This article aims to examine what works in architectural work produce results in the form of cost savings in project planning that are more economical, without reducing the quality or quality of the planning; and the magnitude of the cost savings obtained from applied value engineering. Quantitative research approach. This study examines value engineering focusing on the type of Architectural Work. The data of this study include: (i) primary data with data collection techniques through interviews and observations. (ii) secondary data collected from literature and documentation studies. The data analysis technique includes five stages, namely the information stage, the creative stage, the analysis stage, the development stage, and the recommendation/presentation stage. The results showed that savings were made for wall work (replacing red bricks with tela bricks), frame work, doors and windows (replacing aluminum ex Alexindo in wood color in Cost Budget Plan with aluminum ex Alexindo plain/silver); as well as floor work (replacing ex Roman ceramics with ex KIA). The value of cost savings (cost savings) obtained with the recommended alternative, namely: the weight of the Architectural work is 7.7%, while the weight of the overall work is 2.6%*
***Keywords:*** *Value engineering, architecture, walls, windows, doors; floor.*

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## I. INTRODUCTION

In the field of infrastructure / construction impact of the Covid 19 pandemic is also felt, the budget is relocated for health care so that many infrastructure projects / buildings are delayed or hampered development. One of them is the planning project of the Navy Unit Building in West Papua which is a state-owned building that must be planned with budget constraints especially in the midst of the Covid 19 pandemic situation.

The planned Navy Unit Building project will be built in West Papua. Building with a land area of 8,052 m2, a building area of 1,523.75 m2 with a value of Engineering estimate (EE) Rp 20,164,889,000 (twenty billion one hundred sixty-four million eight hundred and eighty-nine thousand rupah). The building is planned to consist of three building units, namely the main building consisting of 2 floors, and a right wing building 1 floor and left wing 1 floor.The building should be planned with the use of cost-effective without compromising the quality or quality of the building.

In the construction of the Naval Unit Office Building in the environment requires a small cost, it is necessary to have the right planning decisions in order to use the budget to be efficient. Based on this, the author is interested in conducting research on Value Engineeringon thework of architecture. The reason why the field of architecture was chosen to be the object of this research is because: (i) The amount of value of architectural work in Cost Plan is the largest compared to other work. Therefore, based on Pareto's shortness, value engineering analysis should be conducted against the greatest value. (ii) Architectural work was chosen for value engineering analysis, because material changes in architecture do not interfere with the structure of the strength of the building. Material changes in architecture are assumed to still have an equivalent function in the building when compared to the previous type of material.

With the background outlined above, an analysis of the :

1. Any work in architectural work that results in more economical project planning cost savings, without compromising the quality or quality of the planning?
2. How much Cost Savings obtained from Value Engineering applied?

## II. THEORETICAL FOUNDATION

Value engineering is a multidisciplinary decisionmaking process that is systematic and structured. perform function analysis to achieve the best value of a project by defining the functions necessary to achieve the desired value goals and providing those functions at optimum cost, consistent with the required quality and performance(berawi, 2014) [1].

Many experts conduct value engineering assessment to focus on economic value. *(value engineering guide–module i workshop save-I)*[2] said that the economic value is divided by some categories, mainly:

1. Cost value, is a total cost of producing a particular item, is the amount of labor costs, materials, tools and overheads.
2. exchange value, which is a measure of the nature and quality of the product that makes someone sacrifice something to get the product.
3. esteem value, which is a measure of all the properties and privileges that make the owner feel more appreciated.
4. usability value, is a work or service that can be produced by the product or that can be helped produced by the product.
5. real value, which is the level of acceptance of products by consumers and is the final index of economic value**.**

Value engineering work plan is a good tool to do studies from start to finish. this plan can guarantee the best consideration that has been given to all aspects required in a study. work plan divides the study into various elements of the.

According to dell'isola (1975) [3]value engineering work plan is divided into four stages, namely:

1. The information stage fully identifies the building structure system and construction implementation system, identify the functions and cost estimates that are fundamental to the main functions. information stage is the initial stage in drawing up a value engineering work plan that aims to collect data related to the work items to be analyzed, to obtain work items that will be done value engineering by defining the function of items in the project.
2. The creative stage seeks alternatives to fulfill the main functions. this stage to bring up alternatives of elements that still fulfill that function, then systematically arranged. such alternatives can be reviewed from various aspects, including: materials or materials; ways or methods of execution of the work; time of work implementation,
3. The analysis phase of this analysis is conducted on alternatives including: profit-loss analysis, project lifecycle cost analysis, and criteria weighting analysis in alternative selection analysis to obtain potential alternatives.
4. The stage of development, is to prepare the final advice or recommendations in writing for the selected alternatives. development steps are to create concepts/designs to compare with each other, and compare the original concept with the proposed/alternative design.
5. The recommendation stage prepares recommendations from the selected alternatives taking into account the technical and economic implementation of the.

## III. METHODOLOGY

The research approach is quantitativeCooper dan Schindler (2014:146-148) [4]quantitative approach seeks to appreciate the measurement of something. Efforts to analyze the problems in this study is to use the method of value engineering studies. The object taken in this study is the Naval Unit Building Planning Project located in West Papua.

**Research object**

This study will examine value engineering that focuses on the type of Architectural Work. Included in the architectural work are the work of the outer shell (façade), the work of wall/partition pairs, door and window work, floor work, ceiling work, and other special work (Fanny Siahaan, 2015) [5].for those included in the object of the study are: Pictures of planning, Budget Plan Costs, Calculation of design/construction, data on local conditions and others relevant to this study.

**Research Data**

This research data includes:

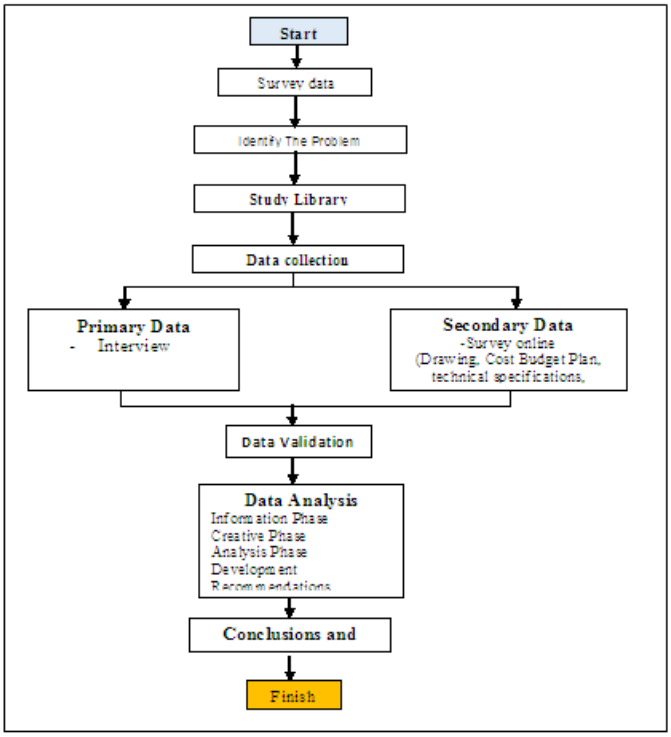
1. Primary data with data collection techniques through interviews and observations.
2. Secondary data is collected from literature studies and documentation. Literature studies are conducted through tudi literature, while the study of documents through tudi against aslui data that is refined from the

contingency. Data obtained from Naval buildingproject consultants in the form of (i) Planing Drawing (ii) Cost Budget Plan, (iii) Planning Report including sondir data, calculation of structure. (iv) Technical Specifications used; (v) Data on unit price lists and analysis of workers, data on materials or building materials used, labor data, (vi) data that can be used as a reference in analyzing value engineering.

**Data Validation**

Data validated by content validity, criteria validity, and validity construct(Budiastuti & Bandur, 2018: 147) [6]. Data analysis techniques cover five stages, namely is a (i) Information Phase, (ii) Creative Phase, (iii) Analysis Phase, (iv) Development Phase, and (v) Recommendation /Presentation.

**Research phase**




## IV. RESULTS AND DISCUSSION

The Navalbuilding, located in West Papua Province, has the characteristic that the structure of the building is reinforced concrete construction. The building consists of building A (*main building*) two storeys, Building B (*right wing*) one floor, and Building C (*left wing*) 1 floor. The type of building is a State Building. The function of the Building is for the kestuan office. Cost per square meter (*for physical building of structure, architecture, and ME; outside sapras*) Rp 9.7 million / m2 (based on Cost Budget Plan data). Project value IDR 20,164,889,000.00 (*Twenty billion one hundred sixty-four million eight hundred and eighty-nine thousand rupiahs*)

Tabel.4.3.Recapitulation of the Overall Cost

| NO. | JOB DESCRIPTION | TOTAL PRICE ( Rp. ) |
|---|---|---|
| 1. | PREPARATORY WORK | 1,178,716,700.00 |
| 2. | STRUCTURE WORK | 5,033,724,417.00 |
| 3. | ARCHITECTURAL WORK | 6,185,643,696.00 |
| 4. | MECHANICAL & ELECTRICAL WORK | 3,594,761,495.00 |
| 5. | LANDSCAPE JOBS | 2,338,871,797.00 |
| | | |
| | SUM | 18,331,718,105.00 |
| | 10% VAT | 1,833,171,810.50 |
| | TOTAL | 20,164,889,915.50 |
| | ROUNDED | 20,164,889,000.00 |

**Cost Model**

Based on the cost model, it can be sorted from the highest cost to the lowest cost to make it easier to know which work is most affecting the construction project of the naval Unit Building in West Papua. There are five jobs overall, in pareto order, architectural work is the largest cost (33.74%), then next is structural work (27.46%), mechanical &electrical work (19.61%), landscape work (12.76%), preparation (6.43%).

Based on table 4.1 Architecture work has the highest job weight, then in table 4.2 we Pareto analysis again to get architectural work items that cost tingi that allows to be done value engineering.

Table.4.1.Table pareto overall job Cost Plan

| NO. | JOB DESCRIPTION | TOTAL PRICE ( Rp. ) | Price Percentage (%) | Cumulative Percentage (%) |
|---|---|---|---|---|
| 1. | ARCHITECTURAL WORK | 6,185,643,696.00 | 33.74 % | 33.74 % |
| 2. | STRUCTURE WORK | 5,033,724,47.00 | 27.46 % | 61.20 % |
| 3. | MECHANICAL & ELECTRICAL WORK | 3,594,761,495.00 | 19,61 % | 80.81 % |
| 4. | LANDSCAPE JOBS | 2,338,871,797.00 | 12.76 % | 93.57 % |
| 5. | PREPARATORY WORK | 1,178,716,700.00 | 6.43 % | 100.00 % |
| | SUM | 18,331,718,105.00 | | |
| | 10% VAT | 1,833,171,810.50 | | |
| | TOTAL | 20,164,889,915.50 | | |
| | ROUNDED | 20,164,889,000.00 | | |

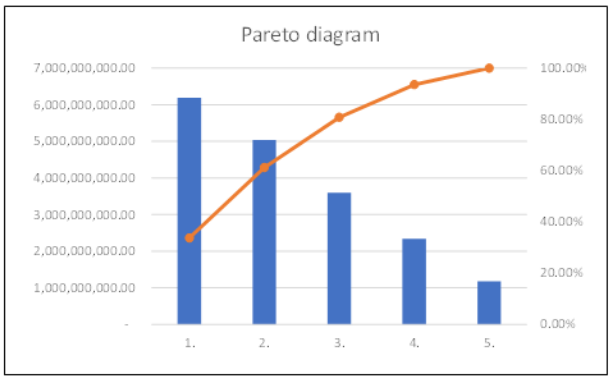
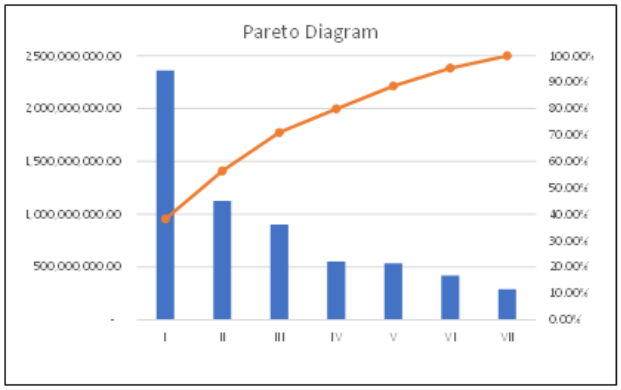



Figure 4.1. Pareto Graphoverall job

Table. 4.2. Tablepareto Architectural Work

| NO. | JOB DESCRIPTION | TOTAL PRICE ( Rp. ) | Price Percentage (%) | Cumulative Percentage (%) |
|---|---|---|---|---|
| | | | | |
| I | WALL COUPLE WORK | 2,362,010,550.00 | 38.19% | 38.19% |
| II | WORK FRAME, DOOR, WINDOW | 1,126,046,804.00 | 18.20% | 56.39% |
| III | FINISHING FLOOR WORK | 901,173,606.00 | 14.57% | 70.96% |
| IV | ROOFING WORK | 553,348,606.00 | 8.95% | 79.90% |
| V | PAINTING FINISHING WORK | 536,087,152.00 | 8.67% | 88.57% |
| VI | WORK CEILING | 418,598,078.00 | 6.77% | 95.34% |
| VII | SANITAIR JOBS | 288,378,900.00 | 4.66% | 100.00% |
| | TOTAL | 6,185,643,696.00 | | |

Figure. 4.2. Pareto graphArchitectural Work




Then from pareto analysis in table 4.2 then obtained the architecture work item with the highest cost, and obtained items of Architecture items that allow to be done Value Engineering that is:

1. Wall Couple work
2. Sill Jobs, Doors, Windows
3. Floor Work

**Diagram FAST**

After doing Pareto Analysis then described FAST Diagram on the work item to know the accuracy of the function of the work items to be done Value Engineering.

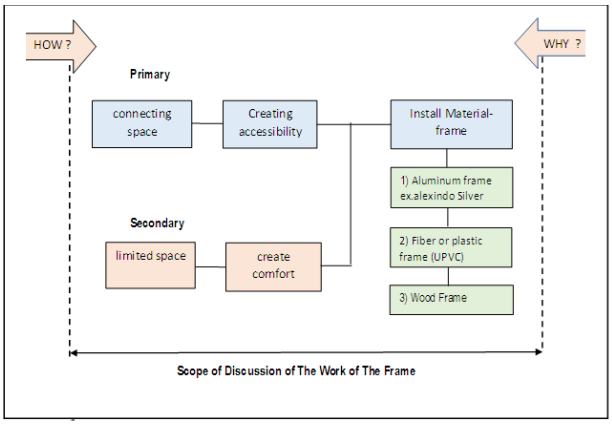



Figure.4.3.a. digram FAST wall work

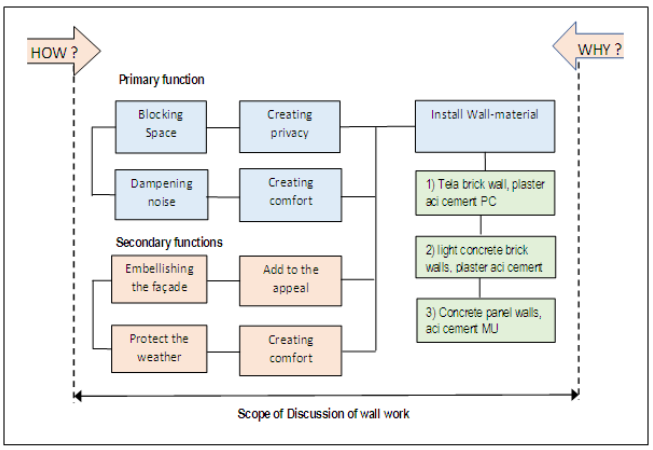



Figure 4.3.b. Diagram FAST work frame

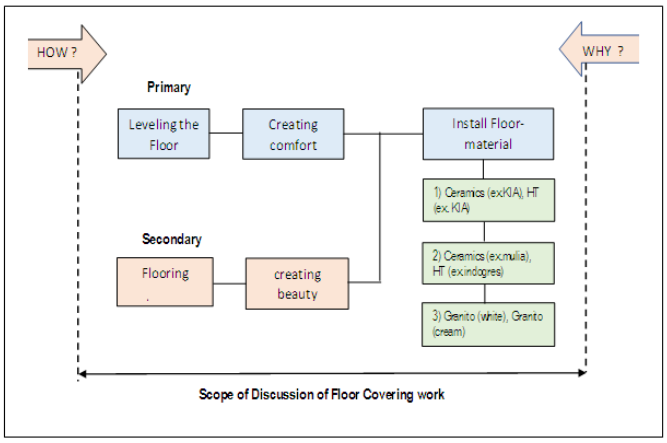



Figure 4.3.c.Diagram FASTFinishing floor work

**Function Analysis**

Next is to perform the Analysis function At this stage will be identified the function of the selected item item consisting of active verbs and nouns against the highest value work items that are:

1. Wall work;
2. Frame,door, windows work; and
3. floor work.

Table 4.3.a. Analysis of wall work function

**INFORMATION STAGE**
**ANALYSIS OF FUNCTIONS**

**Items : Wall Couple Jobs**
**Function : Limiting Space**

| NO. | JOB DESCRIPTION | Function | | type | Cost | Worth |
|---|---|---|---|---|---|---|
| | | Verb | Noun | P / S | ( Rp. ) | ( Rp. ) |
| I | WALL COUPLE WORK | | | | | |
| 1 | Installing red brick walls (1/2 brick spesi 1:4) | Limiting | Room | P | 618,886,411.00 | 618,886,411.00 |
| 2 | Plastering (1 PC : 4 PP) thick 15 mm | Flatten | Wall | P | 523,881,148.00 | 523,881,148.00 |
| 3 | Installing acian | Smoothed | Wall | P | 367,959,918.00 | 367,959,918.00 |
| 4 | Make practical columns and ring reinforced concrete blocks | Strengthen | Wall | S | 317,818,365.00 | - |
| 5 | Installing red brick walls (trasram) 1/2 Brick spesi 1:2 | tapping | Wall | P | 219,802,716.00 | 219,802,716.00 |
| 6 | Plastering (trasram) 1 PC:2 PP thick15mm | Flatten | Wall | P | 152,667,792.00 | 152,667,792.00 |
| 7 | Plastering skoning/water rope 1 PC:2 PP wide 3cm | Beautify | Wall | S | 89,963,200.00 | - |
| 8 | Expose column weaning jobs | Smoothed | column | S | 44,426,880.00 | - |
| 9 | Installing Railing ladders height =0.9m (hollow 50x50,40x20) | Beautify | Ladder | S | 15,954,120.00 | - |
| 10 | Installing the Logo TNI AL | Beautify | Building | S | 10,650,000.00 | - |
| | | *Total 1* | | | 2,362,010,550.00 | 1,883,197,985.00 |
| | | | | C / W | 1.25 | |

Table 4.3.b. Analysis of the frame Workfunction

**INFORMATION STAGE**
**ANALYSIS OF FUNCTIONS**

**Items : Frame doors, windows jobs**
**Function : Connecting Spaces**

| NO. | JOB DESCRIPTION | Function | | type | Cost | Worth |
|---|---|---|---|---|---|---|
| | | Verb | Noun | P / S | ( Rp. ) | ( Rp. ) |
| II | FRAME, DOOR, WINDOW WORK | | | | | |
| 1 | Install Frame Door, Window Leaves | Access | Room | P | 1,052,272,200.00 | 1,052,272,200.00 |
| 2 | Installing gypsum partitions 9 mm frame Hollow (PR2) height =1,2m | Seal | Room | S | 23,989,524.00 | - |
| 3 | Installing gypsum partitions 9mm frame Hollow PR1 (full) | Seal | Room | S | 15,814,080.00 | - |
| 4 | Installing Partitions Type Pa1 | Seal | Room | S | 12,953,400.00 | - |
| 5 | Installing the Main Door Frame Portal | Seal | Room | S | 9,791,600.00 | - |
| 6 | Installing Partitions Type Pa4 | Seal | Room | S | 4,317,800.00 | - |
| 7 | Installing Partitions Type Pa6 | Seal | Room | S | 2,158,800.00 | - |
| 8 | Installing Partitions Type Pa3 | Seal | Room | S | 1,943,000.00 | - |
| 9 | Installing Partitions Type Pa5 | Seal | Room | S | 1,727,000.00 | - |
| 10 | Installing Partitions Type Pa2 | Seal | Room | S | 1,079,400.00 | - |
| | | | | *total* | 1,126,046,804.00 | 1,052,272,200.00 |
| | | | | C / W | 1.07 | |

Table 4.3.c. Analysis of floor work function

**INFORMATION STAGE**
**ANALYSIS OF FUNCTIONS**

**Items : Floor Work**
**Function : Limiting Space**

| NO. | JOB DESCRIPTION | Function | | type | Cost | Worth |
|---|---|---|---|---|---|---|
| | | Verb | Noun | P/S | ( Rp ) | ( Rp ) |
| V | FLOOR WORK | | | | | |
| 1 | Installing 60x60 Polish Floor Tiles | Clean up | Floor | P | 296,695,200.00 | 296,695,200.00 |
| 2 | Installing Ceramic Floor HT 60x60 | Clean up | Floor | P | 250,391,325.00 | 250,391,325.00 |
| 3 | Installing Wall Ceramics 30x60 | Beautify | Wall | S | 179,647,250.00 | - |
| 4 | Installing Plin Floor HT 10x60 | Beautify | Wall | S | 40,045,100.00 | 40,045,100.00 |
| 5 | Installing Ceramic Floor tiles uk.30x30 | Clean up | Floor | P | 38,409,681.00 | |
| 6 | Installing Concrete rebate floor around the building | Clean up | Rabat | S | 22,078,218.00 | |
| 7 | Installing Andesite Stone Floor Coating 400X400 Fin. Coating | Clean up | Floor | S | 21,472,308.00 | |
| 8 | Installing HT. Un Polish Floor Tiles 60x60 | Clean up | Floor | P | 17,404,500.00 | |
| 9 | Installing HT. Flooring uk.60x30 | Clean up | Floor | P | 13,668,900.00 | |
| 10 | Installing Ceramic Floor Plin 10x60 | Clean up | Wall | S | 11,222,400.00 | |
| 11 | Making Concrete Table Pantry and Westafel | Holder | Wastafel | S | 4,614,948.00 | |
| 12 | Install ceramic table sink 60x60 | Clean up | Wastafel | S | 2,792,538.00 | |
| 13 | Installing ceramic table sink granito 60x60 | Clean up | Wastafel | S | 1,651,536.00 | |
| 14 | Installing ceramic table pantry 30x30 | Clean up | Pantry | S | 665,202.00 | |
| 15 | Installing Ceramic Floor List 30x30 | Beautify | Floor | S | 414,500.00 | |
| | | | | *Total* | 901,173,606.00 | 587,131,625.00 |
| | | | | C / W | 1.53 | |

From the Analysis function has a value of C / W above 1, then the work items that can proceed to the creativity stage that is:

1. Install wall work, on item items:
1. Installing red brick wall 1/2 brick spesi 1: 4
a. Installing plastering 1 PC: 4 PP thick 15 mm
b. Installing red brick walls (trasram) 1/2 Brickspesi 1:2
c. Installing plastering (trasram) 1 PC:2 PP thick 15mm
2. Door Frame Jobs, Windows on Items:
1. Installing Sills and Window Leaves
3. Floor Work on Items :
a. Installing Floor Tiles 60x60 Polish
b. Installing Floor Tiles HT.60x60
c. Installing Ceramics 30 x 60

**PhaseCreative**

Then at the creative stage, based on discussions with five speakers who used to work on similar objects and some experts who are used to building similar buildings.In this creative analysis that will be analyzed is the opportunity to obtain alternative use of materials / materials and costs, because this is in accordance with the first research question. The first research question reads: "With Value Engineering Analysis whether to obtain alternative use of materials / materials and costs, without compromising the quality on Architectural Work Items in Naval Unit Building Planning"

1.Intalling wall work

Related to wall work the highest average value in determining alternative wall material is alternative 1 namely Tela Brick Wall, Cement Plaster PC, Acian Cement PC with a value of 21, alternative 2 namely Light Concrete Brick Wall Plaster MU Acian MU worth 19.8, and alternative 3 namely Wall Panel concrete Precast, Acian MU worth 19.6. Thus obtained data that the best alternative to wall material based on matrix determination of alternative wall material is alternative 1 namely Bata Tela wall, Plaster Cement PC, Acian Cement PC with a value of 21.

Table.4.4.1.Matrix analysis of wall material determination

| No | Alternative | Sources | | | | | | Average |
|---|---|---|---|---|---|---|---|---|
| | | Total (N-1) | Total (N-2) | Total (N-3) | Total (N-4) | Total (N-5) | Grand Total (N-1+ N-2 + N3 + N4 + N5) | |
| 1 | Tela Brick Wall, Cement Plaster PC, Acian Cement PC | 22 | 21 | 20 | 20 | 22 | 105 | 21 |
| 2 | Light concrete brick wall, MU plaster, Acian MU | 21 | 19 | 20 | 19 | 20 | 99 | 19.8 |
| 3 | Precast Concrete Panel Wall, Acian MU | 20 | 20 | 20 | 20 | 18 | 98 | 19.6 |

In terms of feasibility the best alternative options for wall material based on the calculation of the feasibility ranking of alternative wall materials is alternative 1 namely tela brick, cement PC plaster, acian cement PC with a value of 21.40.

Table 4.4.2 feasibility analysis Wall material

| No | Alternative | Sources | | | | | | Average |
|---|---|---|---|---|---|---|---|---|
| | | Total (N-1) | Total (N-2) | Total (N-3) | Total (N-4) | Total (N-5) | Grand Total (N-1+ N-2 + N3 + N4 + N5) | |
| 1 | Tela Brick Wall, Cement Plaster PC, Acian Cement PC | 22 | 22 | 21 | 21 | 21 | 107 | 21.40 |
| 2 | Light concrete brick wall, MU plaster, Acian MU | 21 | 17 | 18 | 17 | 18 | 91 | 18.20 |
| 3 | Precast Concrete Panel Wall, Acian MU | 20 | 16 | 17 | 16 | 17 | 86 | 17.20 |

2. frame, doors, windows works

Related to the work of frame doors, windows, the highest average value in the calculation of material alternative matrix is an alternative 1 is the aluminum frame of aluminum leaves (ex.alexindo plain color / silver) with a value of 22.40, alternative 2 namely fiber or plastic frame (UPVC) with a value of 20.80; and alternative option 3 is wood frame with a value of 19.40. Thus the best alternative choice for frame material based on matrix ranking calculation of the determination of alternative work materials sills, doors, windows is an alternative 1 is the aluminum frame aluminum leave (ex.alexindo plain/silver color) with a value of 22.40

Table4.4.3.Matrix analysis of average determination of Material frame

| No | Alternative | Sources | | | | | | Average |
|---|---|---|---|---|---|---|---|---|
| | | Total (N-1) | Total (N-2) | Total (N-3) | Total (N-4) | Total (N-5) | Grand Total (N-1+ N-2 + N3 + N4 + N5) | |
| 1 | Aluminum frame of aluminum leaves (ex. Alexindo plain/silver color) | 23 | 22 | 23 | 22 | 22 | 112 | 22,40 |
| 2 | Fiber or plastic frame (UPVC) | 21 | 21 | 22 | 20 | 20 | 104 | 20.80 |
| 3 | Wood frame | 20 | 20 | 20 | 19 | 18 | 97 | 19.40 |

Reviewed in terms of feasibility of the best alternative options for frame materials, doors, windows based on the calculation of the feasibility ranking of alternative materials frame doors, windows are alternatives 1 namely aluminum frame aluminum leaves (ex.alexindo plain/silver color) with a value of 22.40.

Table 4.4.4. Feasibility analysis Material frame

| No | Alternative | Sources | | | | | | Average |
|---|---|---|---|---|---|---|---|---|
| | | Total (N-1) | Total (N-2) | Total (N-3) | Total (N-4) | Total (N-5) | Grand Total (N-1+ N-2 + N3 + N4 + N5) | |
| 1 | Polish ceramic floor 60x60 (ex.KIA), Floor HT 60x60 (ex.KIA), ceramic 30x60 (ex.KIA) | 23 | 22 | 22 | 22 | 21 | 110 | 22,00 |
| 2 | Polish ceramic floor 60x60 (ex.Mulia), Floor HT 60x60 (ex.Indogres), ceramics 30x60 (ex.mulia) | 19 | 19 | 21 | 19 | 19 | 97 | 19,40 |
| 3 | Granito 60x60 (white) and 60x60 (cream color),30x60 (pearlwhite) | 16 | 18 | 17 | 16 | 16 | 83 | 16,60 |
| 4 | Carpet Floor | 15 | 17 | 14 | 15 | 15 | 76 | 15,20 |
| 5 | Vinyl Flooring | 15 | 16 | 13 | 15 | 14 | 73 | 14,60 |
| 6 | Parquet Flooring | 14 | 15 | 13 | 15 | 13 | 70 | 14,00 |

3.Floor Work

Related floor work, the highest average value on the matrix calculation for alternative floor covering work 1 ceramic 60x60 Polish (ex.KIA), HT floor 60x60 (ex.KIA) with a value of 21.80. Alternative 2 is 60x60 Polish ceramic flooring (ex.Mulia), HTfloor 60x60 (ex.Indogres) with a value of 20.80. Alternative 3 is Granito 60x60 (white color) and 60 x 60 (cream color) with a value of 19.60. The fourth choise is carpet floor with a valueof 18.00. The fifth choice vinyl with a score of 17.00, and the sixth option is parquet with a value of 16.00. Thus the best alternative choice for floor material based on matrix calculation of the determination of alternative work material floor covering is an alternative 1 is the ceramic 60x60 polish (ex.KIA), HT floor 60x60 (ex. KIA) with a value of 21.80.

Table 4.4.5Matrix analysis of floor material determination

| No | Alternative | Sources | | | | | | Average |
|---|---|---|---|---|---|---|---|---|
| | | Total (N-1) | Total (N-2) | Total (N-3) | Total (N-4) | Total (N-5) | Grand Total (N-1+ N-2 + N3 + N4 + N5) | |
| 1 | Polish ceramic floor 60x60 (ex.KIA), Floor HT 60x60 (ex.KIA), ceramic 30x60 (ex.KIA) | 23 | 22 | 22 | 21 | 21 | 109 | 21,80 |
| 2 | Polish ceramic floor 60x60 (ex.Mulia), Floor HT 60x60 (ex.Indogres), ceramics 30x60 (ex.mulia) | 21 | 21 | 22 | 20 | 20 | 104 | 20,80 |
| 3 | Granito 60x60 (white) and 60x60 (cream color),30x60 (pearlwhite) | 20 | 20 | 20 | 19 | 19 | 98 | 19,60 |
| 4 | Carpet Floor | 18 | 18 | 18 | 18 | 18 | 90 | 18,00 |
| 5 | Vinyl Flooring | 17 | 17 | 17 | 17 | 17 | 85 | 17,00 |
| 6 | Parquet Flooring | 16 | 16 | 16 | 16 | 16 | 80 | 16,00 |

Reviewed in terms of feasibility the best alternative options for Floor materials based on the calculation of the feasibility ranking of alternative materials Floor is an alternative 1 is a ceramic 60x60 Polish (ex. KIA), HT Floor 60x60 (ex. KIA)

Table 4.4.6 Floor material feasibility analysis.

| Subject | Alternative 1 | Alternative 2 | Alternative 3 |
|---|---|---|---|
| The value of wall job savings | 334,210,863.00 | (92,466,084.52) | (1,611,806,213.62) |
| Value saving door frames, windows | 220,882,720.42 | 12,917,810.42 | (110,422,089.58) |
| Floor cover saving value | 92,488,885.49 | 50,435,923.69 | 31,835,115.55 |
| **Total Savings (Rp)** | 647,582,468.90 | (29,112,350.42) | (1,690,393,187.65) |
| **Total Budget Plan Costs Architectural Work** | 6,185,643,696.00 | 6,185,643,696.00 | 6,185,643,696.00 |
| **Percentage Of Material Alternative Savings Against Budget Plan Costs** | **10.47%** | **-0.47%** | **-27.33%** |

From the description above, the author concludes into 3 alternatives for each job and will be discussed further in the Analysis stage, here is a summary of alternative alternative work as stated in the table as follows :

Table 4.4.7. Wall Work Alternatives

| NO | IDEA |
|---|---|
| Existing (Original Plan) | Install Red Brick wall, Cement Plaster PC, Acian Cement PC |
| Alternative 1 | Install Tela Brick wall, Cement Plaster PC, Acian Cement PC |
| Alternative 2 | Couple Light Concrete Brick Wall, MU Plaster, Acian MU |
| Alternative 3 | Concrete Panel Wall Pair, Acian MU |

Table 4.4.8. Frame WorkAlternatives

| NO | IDE |
|---|---|
| Existing (Original Plan) | Aluminum sills of aluminum leaves (ex. Alexindo wood browncolor) |
| Alternative 1 | Aluminum sills of aluminum leaves (ex. Alexindo plain/silver color) |
| Alternative 2 | frame, Fiber or plastic leaves (UPVC) |
| Alternative 3 | frame, wood leaves |

Table 4.4.9. Floor Work Alternatives

| NO | IDE |
|---|---|
| Existing (Original Plan) | Polish ceramic floor 60x60 (ex. Roman), Floor HT 60x60 (ex.Roman,ceramic 30x60 ex.roman) |
| Alternative 1 | Polish ceramic floor 60x60 (ex. KIA),Floor HT 60x60 (ex. KIA), ceramic 30x60 ex. KIA |
| Alternative 2 | Polish ceramic floor 60x60 (ex. mulia), Floor HT 60x60 (ex.Indogres), ceramics 30x60 |

| | |
|---|---|
| | ex.mulia |
| Alternative 3 | Granito floor 60x60 (white color) and 60 x 60 (cream color), 30x60 (pearlwhite color) |

**Analysis Phase**

This analysis phase includes price analysis for each material alternative of the three jobs (wall material, sill material, door, window.

Based on the above value engineering results for three jobs (walls; window sills and leaves; and floor coverings), it can be recapitulated for overall savings as well as for each of the alternative materials in all three jobs. Table 4.5 indicates that the value of saving from some alternatives with its material choices.

Table 4.5. Material savings comparison

| Subject | Alternative 1 | Alternative 2 | Alternative 3 |
|---|---|---|---|
| The value of wall job savings | 334,210,863.00 | (92,466,084.52) | (1,611,806,213.62) |
| Value saving door frames, windows | 220,882,720.42 | 12,917,810.42 | (110,422,089.58) |
| Floor cover saving value | 92,488,885.49 | 50,435,923.69 | 31,835,115.55 |
| **Total Savings (Rp)** | 647,582,468.90 | (29,112,350.42) | (1,690,393,187.65) |
| **Total Budget Plan Costs Architectural Work** | 6,185,643,696.00 | 6,185,643,696.00 | 6,185,643,696.00 |
| **Percentage Of Material Alternative Savings Against Budget Plan Costs** | **10.47%** | **-0.47%** | **-27.33%** |

Based on the results of the price analysis, alternatives 2 and 3 have a greater value in comparison to the value of Cost Budget Plan(-.47%) and (-27.33%), therefore the choice of engineering value that does not change the material spec is an alternative option 1 with a value of 10.47% namely tela brick wall, window frame, aluminum doors ex.alexindo, and ceramic floor coverings ex.KIA

**Development Phase**

This stage of development uses the life cycle cost (LCC) method. LCC analysis in this study was done with several assumptions. First, LCC analysis is not conducted on the building of Naval building as a whole, but rather focused on three material options in the engineering of the value of this study, namely wall work materials, window door frame and partition work materials, as well as floor covering work materials. Second, theoretically LCC data includes three "R", namely Running, Repair, and Replacement which in this study is broadly divided into three costs, namely initial costs, maintenance costs, and demolition costs.

Table 4.6.a.LCC wall material

| Component LCC | Cost Budget Plan | Alternative 1 | Alternative 2 | Alternative 3 |
|---|---|---|---|---|
| | Rp | Rp | Rp | Rp |
| Initial Cost | 1,883,197,985.00 | 1,707,956,325.00 | 1,774,347,612.00 | 3,569,077,335.20 |
| Operating Costs | - | - | - | - |
| Maintenance Costs | 4,241,610,921.20 | 4,241,610,921.20 | 4,207,004,009.16 | 2,896,464,999.21 |
| Demolition Costs | - | - | - | - |
| **Total Cost LCC** | **6,124,808,906.20** | **5,949,567,246.20** | **5,981,351,621.16** | **6,465,542,334.41** |

Table 4.6.b.LCC Frame material

| Component LCC | Cost Budget Plan (B0) | Alternative (B1) | Alternative (B2) | Alternative (B3) |
|---|---|---|---|---|
| | Rp | Rp | Rp | Rp |
| Initial Cost | 1,052,272,200.00 | 894,313,000.00 | 1,036,827,000.00 | 1,219,938,500.00 |
| Operating Costs | - | - | - | - |
| Maintenance Costs | 244,073,205.93 | 244,073,205.93 | 244,073,205.93 | 1,525,954,346.83 |
| Demolition Costs | - | - | - | - |
| **Total Cost LCC** | **1,296,345,405.93** | **1,138,386,205.93** | **1,280,900,205.93** | **2,745,892,846.83** |

Table 4.6.c.LCC Floor material

| Component LCC | Cost Budget Plan (C0) | Alternative 1 (C1) | Alternative 2 (C2) | Alternative 3 (C3) |
|---|---|---|---|---|
| | Rp | Rp | Rp | Rp |
| Initial Cost | 766,778,875.00 | 623,868,384.00 | 666,709,613.00 | 738,247,681.00 |
| Operating Costs | - | - | - | - |
| Maintenance Costs | 583,267,516.72 | 583,267,516.72 | 583,267,516.72 | 583,267,516.72 |
| Demolition Costs | 769,660,502.36 | 626,212,940.25 | 669,215,170.63 | 741,022,085.44 |
| Salvage Value (-) | 294,906,322.86 | 248,182,326.86 | 270,551,708.00 | 277,508,904.57 |
| **Total Cost LCC** | **1,824,800,571.22** | **1,585,166,514.11** | **1,648,640,592.34** | **1,785,028,378.58** |

## V. **RECOMMENDATIONS PHASE**.

Based on the four stages of value engineering above (information stage, creative stage, analysis stage, and development stage), it will be submitted recommendations on the results of the value engineering analysis, namely :

1. Wall Work Recommendations

Recommended design alternatives are alternative 1 (A1) wall material in the initial design namely (installing red brick wall, PC cement plaster, PC cement acian) recommended converted into (installing tela brick wall, PC cement plaster, PC cement acian)

Table 4.7.a.Wall Work Recommendations

| Type | Component | Material Cost (Rp) | Construction Costs (Rp) | (LCC) (Rp) |
|---|---|---|---|---|
| Initial Design (A0) | Installing Red Brick Wall, Cement Plaster PC, Acian Cement PC | 614,415,977.98 | 1,883,197,985.00 | 6,124,808,906.20 |
| Alternative Recommendations 1 (A1) | Installing Tela Brick wall, Cement Plaster PC, Acian Cement PC | 280,205,114.98 | 1,707,956,325.00 | 5,949,567,246.20 |

2.Recommendations for frame doors, window work

The recommended design alternative is an alternative 1 (B1) frame material on the initial design namely (aluminium ex.alexindo wood color) is recommended to be changed to (aluminum ex.alexindo plain color)

Table 4.7.b. Recommendations for frame work

| Type | Component | Material Cost (Rp) | Construction Costs (Rp) | (LCC) (Rp) |
|---|---|---|---|---|
| Initial Design (B0) | Installing Door and Window frame (ex. Alexindo wood color) | 587,181,510.42 | 1,052,272,200.00 | 1,296,345,405.93 |
| Alternative Recommendations 1 (B1) | Installing Door and Window frame (ex. Alexindo plain color) | 366,298,790.00 | 894,313,000.00 | 1,138,386,205.93 |

3.Floor Work Recommendations

The recommended design alternative is alternative 1 (C1), on floor work material on the initial design (C0) namely (60x60 ex.roman floor ceramic, HT.60x60 ex.roman, 30x60 ex ceramic. Roman) is recommended to be (tiled floor 60x60 ex. KIA, HT.60x60 ex. KIA, ceramic 30x60 ex. KIA)

Table 4.7.c. floor work recommendations

| Type | Component | Material Cost (Rp) | Construction Costs (Rp) | (LCC) (Rp) |
|---|---|---|---|---|
| Initial Design (C0) | Installing Floor Tiles 60x60 (ex.roman), Installing Floor Tiles HT 60x60 (ex.roman), Ceramics 30x60 ex.roman | 397,548,761.49 | 766,778,875.00 | 1,824,800,571.22 |
| Alternative Recommendations 1 (C1) | Installing 60x60 Floor Tiles (ex.KIA), Installing Ceramic Floor HT 60x60 (ex.KIA), ceramic 30x60 (ex.KIA) | 305,059,876.00 | 623,868,384.00 | 1,585,166,514.11 |

4. Recapitulation of savings results

From the description above the author can present the Recapitulation of Savings Results Following the recapitulation of the calculation of total construction cost savings and life cycle savings from the results of the replacement of the initial design with the recommended or proposed design

Table. 4.7.d. recapitulation of savings results

| No | Work Items | Construction Costs (Rp) | | LCC (Rp) | |
|---|---|---|---|---|---|
| | | Cost Plan (Initial design) | Recommendations | Cost Plan (Initial design) | Recommendations |
| 1 | Wall Work | 1,883,197,985.00 | 1,707,956,325.00 | 6,124,808,906.20 | 5,949,567,246.20 |
| 2 | Frame Work | 1,052,272,200.00 | 894,313,000.00 | 1,296,345,405.93 | 1,138,386,205.93 |
| 3 | Floor Work | 766,778,875.00 | 623,868,384.00 | 1,824,800,571.22 | 1,585,166,514.11 |
| | Sum | 3,702,249,060.00 | 3,226,137,709.00 | 9,245,954,883.35 | 8,673,119,966.24 |
| | SAVINGS | 476,111,351.00 | | 572,834,917.11 | |
| | PERCENTAGE | 12.86% | | 6.2% | |

Table.4.7.e.Cost Recapitulation and Savings Percentage

| Value Of Architectural Cost Budget Plan | = Rp 6,185,643,696.00 | | | | |
|---|---|---|---|---|---|
| Total Cost Budget Plan Value | = Rp 18,331,718,105.00 | | | | |
| No | Work Items | Construction Costs Rp | | Value Savings (Rp) | percentage Against |
| | | Cost Budget Plan (Initial design) | Alternative 1 | | Cost budget Plan Arch. |
| 1 | Wall work | 1,883,197,985.00 | 1,707,956,325.00 | 175,241,660.00 | 2.83% |
| 2 | Frame work | 1,052,272,200.00 | 894,313,000.00 | 157,959,200.00 | 2.55% |
| 3 | Floor work | 766,778,875.00 | 623,868,384.00 | 142,910,491.00 | 2.31% |
| | JUMLAH | 3,702,249,060.00 | 3,226,137,709.00 | 476,111,351.00 | |
| Total percentage (%) cost savings against Cost Budget Plan Architectural | | | | | 7.70% |
| Total percentage (%) cost savings against Cost Budget Plan Total | | | | | 2.6% |

## VI. CONCLUSION

Based on the results of the study and linked to research questions, it can be concluded that:

1. Obtained alternative materials for three Architectural works on the Naval Building project in West Papua.
   a. aAlternative materials for wall work (red brick in the initial Cost Budget Plan)consists of three alternative materials, namely alternative 1 (tela brick), alternative 2 (light brick), and alternative 3 (concrete panel). Based on the results of value engineering, from the three alternative materials of wall materials, then the tela brick material (alternative 1) is the best alternative.
   b. Alternative materials for the work of sills, door leaves and windows (aluminum ex Alexindo wood color on cost budget plan) consists of alternative 1 (aluminum ex.alexindo plain color / silver), alternative 2 (UPVC materials), and alternative 3 (wood materials). Based on the engineering results of the values of the three alternatives, the materials of aluminimum frame ex.alexindo plain color / silver (alternative 1) is the best alternative.
   c. Alternative materials for floor covering work (ceramic 60x60 ex.roman, HT 60x60 ex.roman, ceramic 30x60 ex.roman on budget cost plan) consists of an alternative 1 (ceramic 60x60 ex. KIA, HT 60x60 ex. KIA, ceramics 30x60 ex.KIA), alternative 2 (ceramic 60x60 ex.mulia and HT 60x60 ex. Indogress, ceramic 30x60 ex.mulia), alternative 3 (granito floor 60x60 white color, 60x60 cream color, 30x60 pearlwhite color), based on the results of engineering value, of the three alternative materials floor covering material, then ceramic material ex.KIA (alternative 1) is the best alternative.

2. The amount of savings obtained from Engineering The value applied to the three jobs (walls; sills and leaves of windows, doors and partitions; and floor coverings), the savings obtained by replacing alternative materials on all three jobs are :
   a. If using the first alternative (wall material with brick tela, plaster cement PC, acian cement PC), door frame material, window with (aluminum ex.alexindo plain color), and floor material with (ceramic 60 x 60 ex. KIA, HT 60 x 60 ex. KIA, ceramic 30x60 ex. KIA) is Rp.476.111.351,00 or 7.7% (sevenpoint seven percent) of the value of architectural work budget plan (Rp.6.185.643.696,00).
   b. If using alternatives both wall materials with (light brick, MU cement plaster, MU cement acian), door frame material, window with (UPVC), and Floor material with (ceramic 60x60 ex.mulia, HT.60x60 ex.indogress, ceramics 30x60 ex.mulia) is Rp. 224.364.835,00 or 3.63 % (three point six three percent) of the value of architectural work budget plan (Rp. 6.185.643.696,00).
   c. If using a third alternative (wall material with light concrete panels acian MU cement), door frame material, windows (with wood frame), and floor material with (granito 60x60 white color, granito 60x60 cream color, granito 3x60 pearlwhite) is more expensive (Rp.1,781,554,756.20) (-28.8%) (minus two eight point eight percent) than the value of architecture work budget plan (Rp. 6,185,643,696.00).

3. Cost savings obtained with the recommended alternatives are: precentage to Architecture work by 7.7%, while precentage to total work of 2.6%.

Based on the results of research that has been done, it can be submitted some suggestions that should be done in the effort to value engineering on the construction plan of a building, namely :

1. In the process of analysis of value engineering There needs to be more knowledge and insight about alternative design and materials / building materials
2. The results of this study can be a reference for project owners, consultant planners and implementing contractors in the budgeting plan for the Construction of Naval Unit Buildings in West Papua, as well as the need for further research in the application of *value engineering* analysis on this project, especially related to arsitektur work.

For further research, an integrated discussion and coordination between value engineering experts, Project owners and Consultant Planners is required to examine in more depth and thoroughly the components of other work so that efisisen construction costs will be obtained.

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