Readiness and Influence of Value Engineering Implementation at the Construction Center of the Ministry of Defense of the Republic of Indonesia

by Resi Bismantara, Dwi Dinariana, Arman Jayady, Fitri Suryani, Hari Nugraha

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Research Paper

Readiness and Influence of Value Engineering Implementation at the Construction Center of the Ministry of Defense of the Republic of Indonesia (Case Study of Belawan Hospital Construction)

Resi Bismantara[a], Dwi Dinariana[b], Arman Jayady[c], Fitri Suryani[d], Hari Nugraha[e]

[a]*Student of Master's Program in Civil Engineering Engineering and Construction Project Management, University of Persada Indonesia-YAI, Jakarta,*
b Lecturer of the Master of Civil Engineering Engineering and Construction Project Management Program, University of Persada Indonesia -YAI, Jakarta,
c Lecturer of the Master of Civil Engineering Engineering and Construction Project Management Program, -YAI -YAI, Jakarta,
d Lecturer of the Master's Program in Civil Engineering Engineering and Construction Project Management, -YAI -YAI, Jakarta,
e Lecturer of the Master of Civil Engineering Engineering and Construction Project Management Program, -YAI -YAI, Jakarta,

Abstract. *The current condition of the Construction Center of the Ministry of Defense of the Republic of Indonesia (Construction Center) has not implemented value engineering in the implementation of construction development. The research is intended to determine how much influence the application of value engineering methods has in increasing value and how ready the institution is to apply the value engineering method. To achieve these two objectives, the researcher uses the method of applying 6 stages of value engineering studies, Life-Cycle Cost Analysis, frequency distribution analysis, multiple linear regression analysis and correlation analysis. The results of the value engineering study on the construction of the Belawan Hospital in Medan resulted in savings of Rp. 3,592.415,520.0 or 5.05 percent of the value of the building, increasing the value in terms of environmentally friendly functions, durability of walls, preventing excessive humidity in the room and saving time for plastering implementation as much as 6373 peopleday. The research also proves that the Construction Center is not yet fully ready to implement value engineering studies where the relationship between the readiness to apply the VE study at the Construction Center (Y) as the dependent variable, and the availability of defense secrecy regulations, the availability of VE study regulations, the availability of detailed guidance on VE and the availability of service provider support (X1,X2,X3 and X4 respectively as independent variables) is described in the equation Y = - 0.959 + 0.284 X1 + 0.457 X2 + 0.239 X3 + 0.217 X4.*

Keywords: *Value Engineering, Construction Center*

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I. PRELIMINARY

1.1 Background

Until now, the Construction Center has not conducted a value engineering (VE) study in its construction. Based on the literature the application of VE studies is one method that can increase the value of a building. Taking this into account, it is necessary to investigate whether the VE study at the Construction Center has an effect on the value of the building and to what extent the Construction Center is ready to implement the VE study. Without these two studies, efforts to achieve efficiency and maximize building functions can be constrained.

1.2 Problem Formulation

The formulation of the problem can be divided into two things, namely the formulation of the problem and the significance of the problem

1.2.1 Problem Formulation

a. Until this research, the effect of the VE study on the construction of defense facilities and infrastructure at the Construction Center is unknown;

b. Until this research, the condition of readiness for the VE study at the Construction Center is unknown.

1.2.2 Significance of the Problem

a. Lack of understanding that VE studies can increase the value in the Construction Center, so that currently and in the future efforts to increase the value of buildings will be difficult to achieve;

b. The unknown condition of readiness at the Construction Center to implement the VE study results in difficulties in preparing steps to accelerate the achievement of readiness for the implementation of the VE study.

I.3 Research Questions

a. Research Question-1 is how much influence the application of the VE study has in improving function or reducing costs or both in the construction of Belawan Hospital.

b. Research Question-2 is what is the state of readiness for implementing the VE study at the Construction Center?

1.4 Research Objectives

a. Applying 6 stages of the VE study in the construction of Hospital X to find out how much influence the application of the VE method has in increasing function or decreasing costs (cost) or both (value);

b. Applying statistical analysis to determine the condition of readiness for VE implementation at the Construction Center.

1.5 Research Benefits

a. The VE study on the construction of Belawan Hospital is useful for determining the work that needs to be carried out by VE studies to increase the value of the building and provide recommendations on the importance of implementing VE studies at the Construction Center in the future;

b. Research on the condition of readiness for the application of the VE study at the Construction Center to determine steps to accelerate the achievement of readiness for the application of the VE study at the Construction Center.

II. LITERATURE REVIEW AND HYPOTHESES FORMULATION

2.1 Value Engineering Method

Value engineering is an effort carried out in a systematic and organized manner to analyze a system function, product, service with a view to achieving or carrying out essential functions with the lowest life cycle cost and consistent with the required performance, reliability, quality and safety. Dell'isola 1975, Zimmerman and Hart, 1982).

In the Body of Knowledge which is the SAVE International Value Standard in the 2007 Edition, the value engineering methodology is a structured system/procedure that aims to increase a value. The procedure is divided into 3 (three) stages, namely the Pre-Study Stage (Pre Workshop/Study), the Study Stage (Value Job Plan), and the Post-Study Stage (Post Workshop/Study).

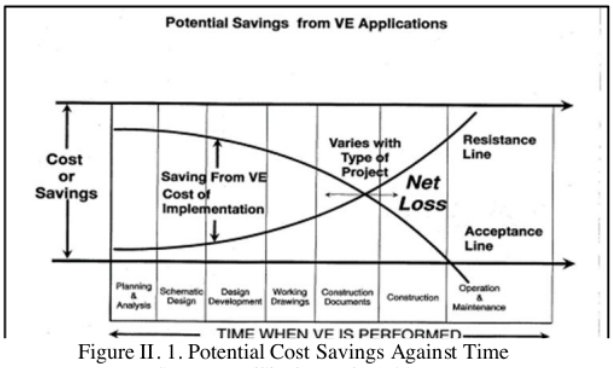


Figure II. 1. Potential Cost Savings Against Time
Source: Dell'isola, et.al., (1997)

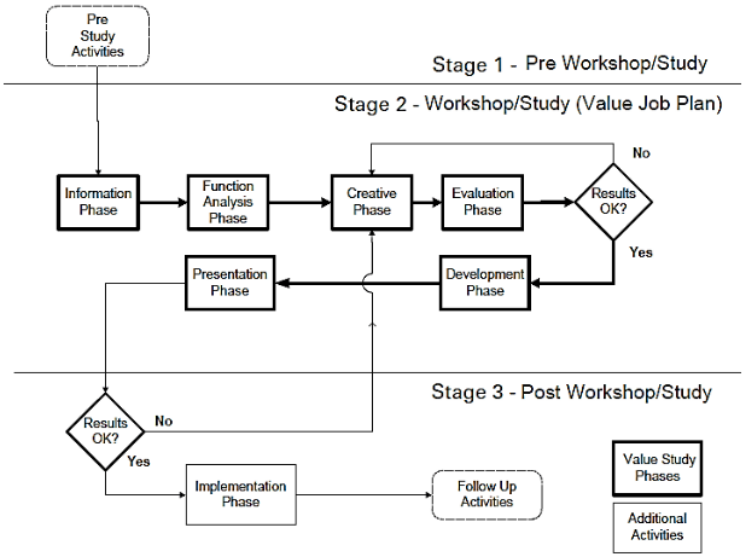


Figure II.2 VE . Study Diagram
Source: SAVE International Value Standard Edition 2007

a. Pre-Study/Workshop Stage

At this stage, information is sought regarding the wishes of the employer's leadership to be achieved by conducting this study, both the necessary needs, priorities considered strategic, as well as ways to increase the value of the organization;

b. Study/Workshop Stage

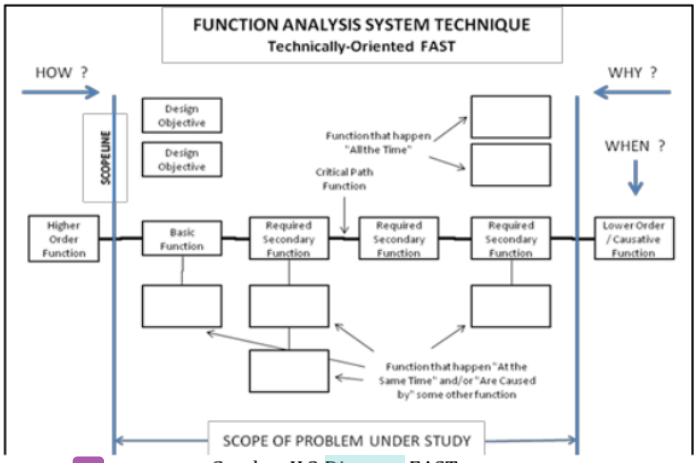
The implementation stage of the VE study is divided into 6 (six) stages, namely the information stage, the function analysis stage, the creative stage, the evaluation stage, the development stage, and the presentation stage. These stages can be briefly described as follows:

1) Information Phase (Information Phase)

This stage is intended for mutual understanding of all team members on the general and basic matters of the project that is the object of study;

2) Function Analysis Phase

Function is the main element in VE, because the goal of VE is to get the required functions from a product/project with the lowest total. Function Analysis System Technique (FAST) is a tool that graphically describes the logical relationship between the functions of an element, subsystem, or facility;



Gambar II.3 Diagram FAST
Sumber : Snodgrass, CVS et all, Function Analysis, 1986)

Figure II.3 FAST Diagram Diagram
Source: Snodgrass, CVS et all, Function Analysis, 1986)

3) Creative Phase

In the creative stage, ideas are developed that produce several alternative functions to increase the value of a particular project. This stage is carried out in several ways, including brainstorming, the gordon technique and so on;

4) Evaluation Phase

The evaluation phase is intended to reduce the number of ideas that have been identified to a short list with the greatest potential to improve project functionality. Next select priority ideas to be further developed in the Development Phase;

5) Development Phase

The development stage is intended to analyze and further develop the list of ideas into several value alternatives. In this stage, alternatives with low-medium-high risk are created;

6) Presentation Phase. The implementation of the study results is an activity to convince the project owner that the selected alternative value is beneficial for the project and can be realized.

c. Post Study/Workshop Stage

The activities carried out after the study are implementation activities as a follow-up to the results of the VE study. The Implementation Phase has the objective of obtaining final approval of the proposal and facilitating its implementation.

2.2 Analysis/ Method Supporting of Value Engineering Study

a. Phareto Analysis

The Pharetto Principle states that for many events, about 80% of the effect is due to 20% of the causes;

b. Delphi method

The Delphi method is based on a structured process to collect and refine knowledge from a group of experts or experts in the sense of a distributed question sheet and controlled feedback (Adler and Ziglio, 1966). Delphi analysis uses a research instrument in the form of a questionnaire. Questionnaire;

c. Cost to Worth Analysis

Cost to Worth Analysis is an analysis by comparing the Cost of a job with Worth (the minimum cost to produce the job function). cost to worth analysis is used to identify the greatest potential for work components with potential savings and value improvements;

d. Pair Comparison Matrix

Pairwise Comparison Matrix is a pairwise comparison method referring to each process of comparing each pairwise variance to assess which of each variance has better performance;

e. Analytical Hierarchy Process (AHP)

AHP is a decision-making method that describes complex multi-factor or multi-criteria problems into a hierarchy that problems will appear more structured and systematic;

f. Life Cycle Cost Analysis (LCCA)

LCCA is a method for assessing the lowest total cost of ownership of a facility by taking into account all costs to acquire, own and operate a building over its service life.

2.3 Statistics

a. Data collection

Data collection is done to obtain the information needed in order to achieve the research objectives. Data collection instruments can be in the form of check lists, questionnaires, interview guidelines, to cameras for photos or recording images;

b. Data processing

Data processing is the process of interpreting field data according to the purpose, design and nature of research and decision-making needs including:

1) Validity testing to measure the accuracy of the research measuring instrument to the actual content as measured using Bivariate Pearson Correlation (Pearson's Product Moment);

2) Reliability Testing or reliability to measure the consistency of a series of measurements or a series of measuring instruments using SPSS software;

3) Frequency Distribution Analysis to obtain the mean, median and mode based on the percentage frequency of each question/statement item in the variable;

4) Linear Regression Analysis to estimate and/or predict the mean (population) value of the dependent variable Y based on the known or defined values of the independent variables X. Linear regression analysis used the method of selecting the regression member variables including the Enter, Backward Forward, Stepwise and Remove methods;

5) Classical/Econometric Assumption Test to verify the statistical requirements that must be met in multiple linear regression analysis based on Ordinary Least Squares (OLS). The classical assumption test used is the normality test R^2test, F test, t test, heteroscedasticity test, multicollinearity test, autocorrelation test and linearity test;

a) Normality test to test whether the residual value is normally distributed or not. Residual is the difference between the observed value and the predicted value and absolute is the absolute value. Normality test can be done by histogram test, normal test P Plot

b) Test R2 (Test of Determination) to test how much influence or variation of the dependent variable can be explained by changes or variations of the independent variable

c) The F test is useful for knowing the linear relationship in the multiple linear regression model;

d) The t test was carried out to test the significance of the linear model, both constants and coefficients of the independent variables;

e) Heteroscedasticity test to test whether the regression model occurs or there is an inequality of variance from the residual from one observation to another;

f) Multicollinearity test to test whether the regression model found a correlation between independent variables;

g) Autocorrelation test aims to test whether in the linear regression model there is a correlation between the confounding error in period t and the confounding error in the previous period using the Durbin-Watson test;

h) Linearity Test to Verify whether the model built has a linear relationship or not.

6) Correlation Analysis using the Pearson Correlation Coefficient or Product Moment for the strength of the relationship between the independent variable and the dependent variable.

Research Hypothesis

Based on the results of previous research on VE studies, literature studies and current conditions, the Construction Center has never implemented a VE study, so the research hypotheses are:

a. The application of the VE study increases the value in the form of increasing functions or decreasing costs in the implementation of the Belawan Medan Hospital Development;

b. The Construction Center is not yet ready to implement the VE study according to international standards.

III. RESEARCH METHODS

3.1 Introduction

The discussion of the research methodology includes the steps to answer RQ-1 and RQ-2 starting with data collection, data tabulation and data processing. In each of these stages, special methods are used according to the material discussed.

3.2 Mindset

3.2.1 Application Research Flow 6 stages of VE Study

Implementation of the 6 stages of the VE Study as illustrated in Figure 3.1

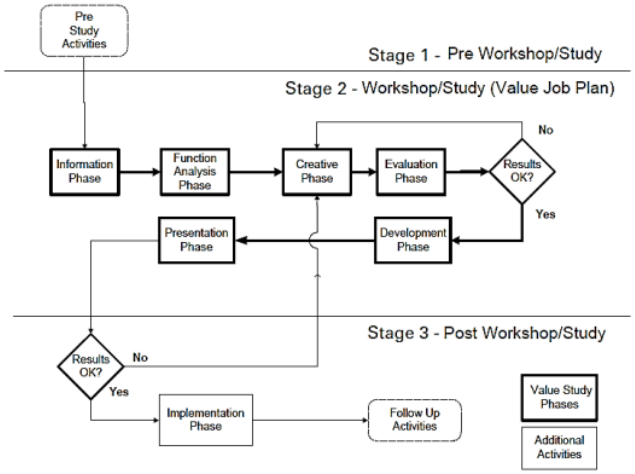


Figure 3.1 International Standard VE Study Diagram
Source: SAVE International, 2007

This research was carried out by analyzing the existing designs using the 6-step VE method. The flow of thought to answer RQ-1 is carried out by a case study by analyzing the planning implementation document of a construction project using the 6 (six) stages of VE method according to the SAVE International Value Standard (2007), Value Standard and Body of Knowledge and the Life Cycle Cost method. analysis (LCCA) to produce the best value in the construction of the Defense Sarpras (case study of hospital construction). The flow of thought to answer RQ-1 is in table 3.1

Research Question	Input (Data)	Process (Method)	Output
1. RQ-1-1 How to determine potential work items for VE	Primary Data (Doc. DED) (Information Phase) 1)	a. Pareto analysis b. Cost to Worth (Information Phase)	Potential Work Items carried out VE (Information Phase)
2. RQ-1-2 How to determine the potential function of VE activities and alternative solutions	VE Potential Job Items (Information Phase)	Function analysis (FAST) (Function Analysis Phase)	a. VE . Activity Potential Function b. Alternative Solution (Creative Phase)
3. RQ1-3 Can VE increase Value by increasing Functionality or decreasing Cost or both	a. VE . Activity Potential Function b. Alternative Solution c. Questionnaire/interview (Evaluation Phase)	a. Delphi method b. Pair comparison matrix c. Decision Matrix d. Life Cycle Cost (LCC) (Development Phase)	VE can increase value by increasing functionality or lowering costs or both (Presentation Phase)

Table 3.1 Mindset of 6 stages of VE in the VE Study at Belawan Hospital

The research methodology to answer RQ-1 uses the Pre-VE Study, VE Study and Post-VE Study stages.

a. In the Pre-study/Workshop stage, information is sought about the wishes of the employer's leadership. The pre-study stage uses the interview and work meeting method or in the form of a directive;

b. The implementation phase of the value engineering study is divided into 6 (six) phases as follows as illustrated in table 3.1:

c. Post Study/Workshop Stage. The activities carried out after the study are implementation activities and follow-up activities from the VE study or implementation phase. The Implementation Phase has the objective of obtaining final approval of the proposal and facilitating its implementation.

3.2.1 VE Study Readiness Research Flowchart at the Construction Center

The research methodology to answer RQ-2, identification of criteria and surveys were carried out to respondents on the criteria for readiness to apply the VE method at the Baranahan Center for the Ministry of Defense of the Republic of Indonesia. The research uses the Delphi method to experts, AHP, Frequency Distribution Analysis, Multiple Linear Regression and correlation analysis on the readiness criteria. The flow of thought to answer RQ-2 is in table 3.2

The research methodology to answer RQ-2 through the stages of data collection using questionnaires, data tabulation, conversion of ordinal data to interval data, Validity Test of Data Reliability Test, Frequency Distribution Analysis, Regression Analysis, Classical Test / Econometric Test (Normality Test, R2 Test, Test F, T test, autocorrelation test, multicollinearity test, heterocadicity test and linearity test) and correlation analysis.

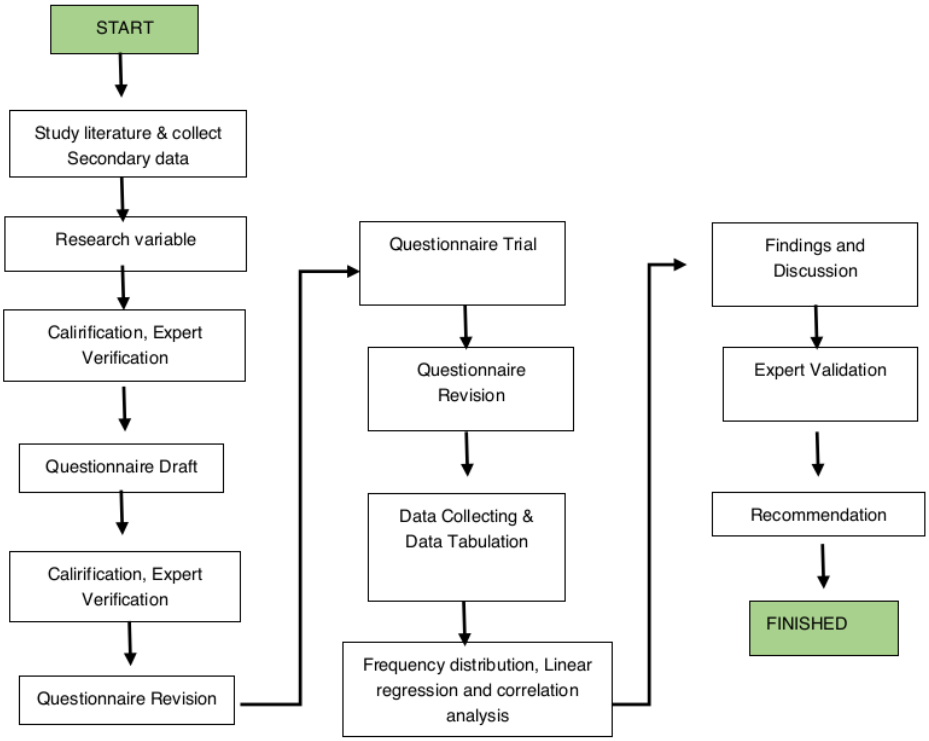


Figure 3.2 Survey Method Research Flow

a. Data collection. Collecting data using a survey method, with the research instrument in the form of a validated questionnaire and then distributed to respondents who can represent the population and taken by sampling. The resulting data includes primary data and secondary data. Primary data was obtained from the results of questionnaires distributed to service users within the Ministry of Defense. Secondary data obtained from the results of literature studies such as books, references, journals and other research related to this research;

b. Data Tabulation. Data tabulation is intended to enter data from certain tables and organize numbers and calculate them;

c. Convert Ordinal Data Into Interval Data. The data from the questionnaire results are classified in ordinal data which cannot be carried out mathematical operations so that they are converted into interval data. Conversion using Method Successive Interval software in Microsoft Excel;

d. Validity Test Data Reliability Test, Frequency Distribution Analysis, Regression Analysis, Classical Test / Econometric Test (Normality Test, R2 Test, F Test, T Test, Autocorrelation Test, Multicollinearity Test, Heterocadicity Test, Linearity Test) and Correlation Analysis is done using software SPSS.

IV. ANALYSIS AND DISCUSSION

4.1 Application of VE Study in Belawan Hospital Construction

4.1.1 Introduction

Discussion of the procedures and/or steps in implementing the VE study, through the information stage, the function analysis stage, the creative stage, the evaluation stage, the development stage and the recommendation stage. The procedure refers to the workbook for value engineering study issued by the American Society of Value Engineers (SAVE) International.

4.1.2 Scope of VE with Phareto Analyst and Cost to Worth Analysis

To estimate the usefulness value (worth) of the work component, the Regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia Number 22/PRT/M/2018 concerning the Construction of State Buildings is used.

Table 4.1 Phareto Analysis and Cost to Worth Analysis

No	Job Description	Total price Rp.	Percent (%)	Accumulative Cost. (%)	Min Cost (%)	Max Cost (%)	C/W Maks	C/W Min	Explanation
1	Structure Work	19,795,140,025.85	27.8	27.8	25.00	35.00	1.11	0.79	
2	Utility work (TME)	19,779,860,260.50	27.8	55.6	10.00	15.00	2.78	1.85	Priority 1
3	Foundation work	9,533,169,847.25	13.4	69.0	5.00	10.00	2.68	1.34	Priority 2
4	Wall and partition work	6,950,044,952.29	9.8	78.7	6.00	8.00	1.63	1.22	Priority 3
5	Ceramic Floor and Wall Works	5,325,792,332.89	7.5	86.2	7.00	10.00	1.07	0.75	
6	Frame, Door and window work	3,238,462,219.00	4.5	90.8					
7	Finishing Work	1,638,433,563.29	2.3	93.1	5.00	10.00	0.46	0.23	
8	Ceiling Work	1,350,606,305.12	1.9	95.0	8.00	10.00	0.24	0.19	
9	Earthwork and compaction	1,020,730,257.81	1.4	96.4					
10	Sanitary Work	866,625,432.00	1.2	97.6					
11	Space Complementary Work	482,818,221.91	0.7	98.3					
12	Preparation	425,073,326.00	0.6	98.9					
13	Roof Work with Steel Frame	407,906,570.64	0.6	99.5	5.00	8.00	0.11	0.07	
14	Front Faade Complementary Work	386,020,362.61	0.5	100.0					

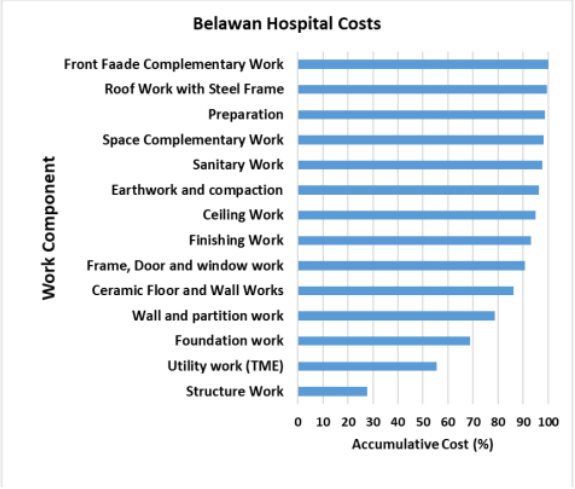


Figure 4.1 Accumulative Cost

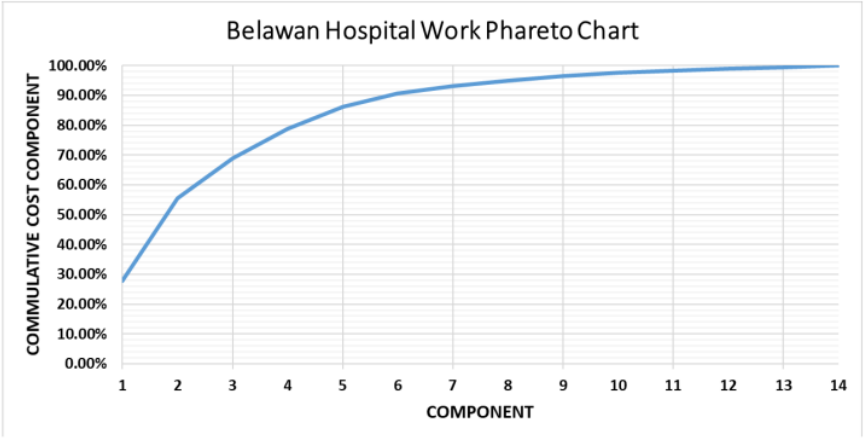


Figure 4.2 Phareto Graph

4.1.3 FAST Diagram

Furthermore, the above functions are arranged in a FAST diagram so that a critical path will be obtained as shown in Figure IV.9 below.

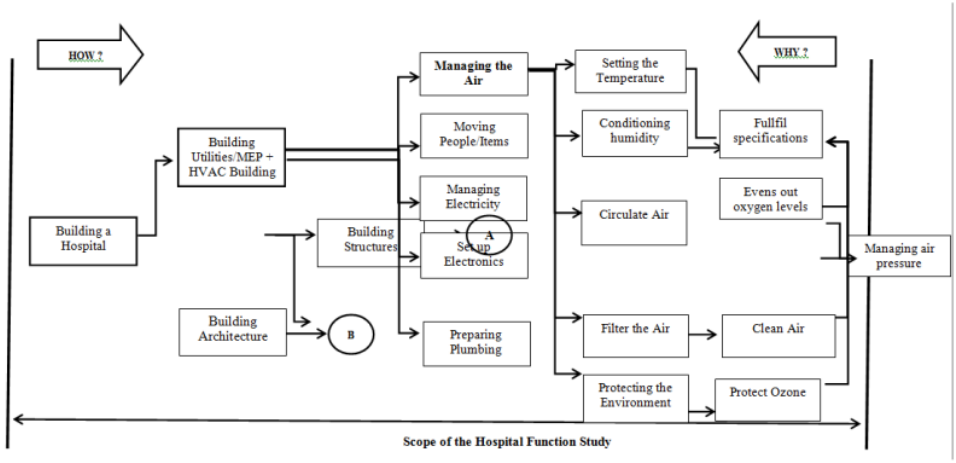


Figure 4.3 FAST Diagram of Belawan Hospital

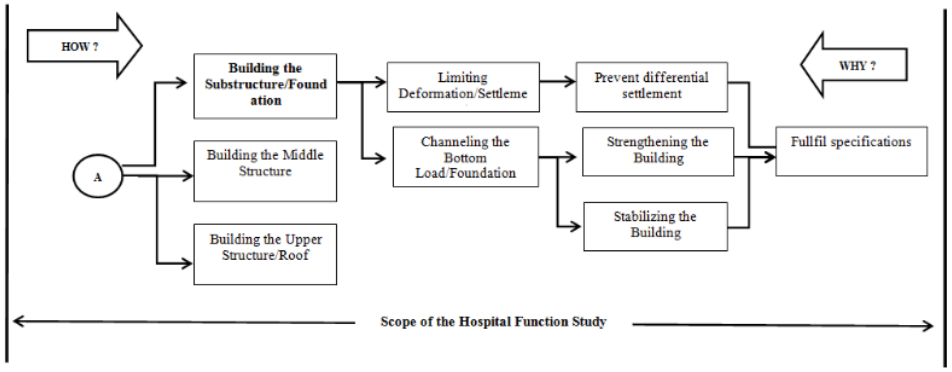
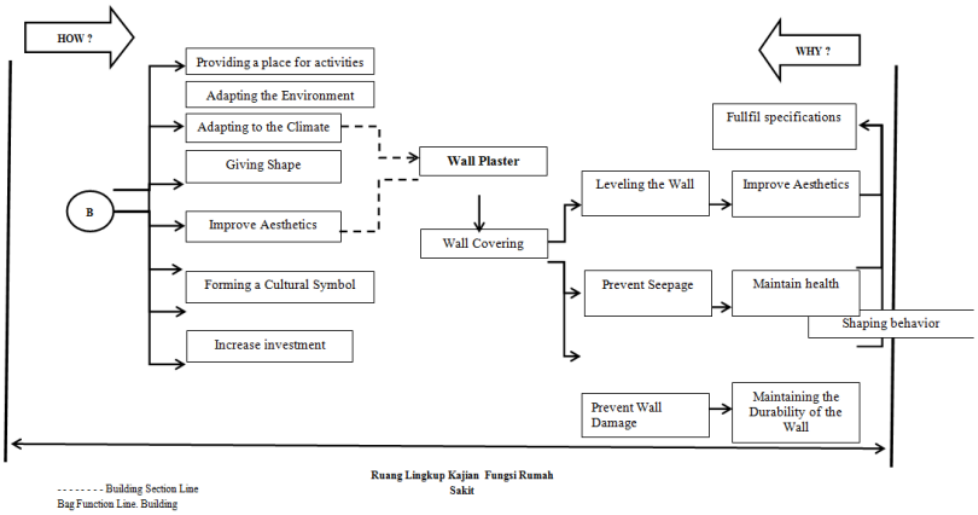


Figure 4.4 FAST Diagram of Belawan Hospital



Scope of the Hospital Function Study

Figure 4.5 FAST Diagram of Belawan Hospital

4.1.4 Creation, Evaluation, Development and Air Conditioning Recommendation Stage

In the creative stage, the refrigerant used is freon and hydrocarbon. The evaluation stage uses the Pairwise Comparison Matrix and Analytical Hierarchy Process (AHP) methods. The results of the evaluation resulted in the hydrocarbon refrigerant being selected as the best refrigerant. development stage. using the Life-Cycle Cost Analysis (LCCA) calculation method as follows:

Table 4.2 Original Air Conditioning Data

No.	Job description	Vol	Unit	Unit Price	Price
1	2	3	4	5	6
1	Central AC Supply	1.00	Ls	-	8,205,970,911.0
2	Operating Cost/Power/Year	1,887,877.33	KVAh	1,114.7	2,104,492,000.0
3	Maintenance cost				103,908,000.0
A	IU Maintenance Cost 6.25 PK/year	97.00	Unt	825,941.0	80,116,000.0
B	IU Maintenance Cost > 6.25 PK/year	16.00	Unt	1,487,005.0	23,792,000.0
4	Salvage			0.2	1,641,194,182.2

Table 4.3 Air Conditioning Data for Refrigerant Replacement

No.	Job description	Vol	Unit	Unit Price	Price
1	2	3	4	5	6
1	Year zero investment				8,219,888,711.0
a	Central AC Supply	1	Ls	-	8,205,970,911.0
b	Procurement of HC Refrig (0.56 Kg / PK)	202	Kg	68,900.0	13,917,800.0
2	Operating Cost/Power/Year (85%)	1,604,695.73	Kvah	1,114.7	1,788,819,000.0
3	Maintenance cost				103,908,000.0
a	IU Maintenance Fee 6.25 PK/year	97.00	Unt	825,941.0	80,116,000.0
b	IU Maintenance Cost > 6.25 PK/year	16.00	Unt	1,487,005.0	23,792,000.0
4	Salvage			0.2	1,643,977,742.2

Table 4.4 LCCA Refrigerant Replacement

NO	Life Cycle 50 Years Interest Rate 14%	Original Design Inflation Refrigerant CFC / Freon Present value	Replace Hydro Carbon Refrigerant Present Value
1	2	3	4
1	Capital Cost	9,516,657,357.97	9,530,575,157.97
	Initial Cost	9,516,657,357.97	9,530,575,157.97
2	Annual Cost a. Operating Cost b. Maintenance cost	 15,010,618,451.30 741,140,067.07	 12,759,031,389.73 741,140,067.07

NO	Life Cycle 50 Years Interest Rate 14%	Original Design Inflation Refrigerant CFC / Freon Present value	Replace Hydro Carbon Refrigerant Present Value
	Total Annual Cost	15,751,758,518.37	13,500,171,456.80
3	Salvage Cost	(2,343,783.01)	(2,347,758.20)
	TOTAL PTRESENT VALUE	25,266,072,093.33	23,028,398,856.57
	LC Present value Saving		2,237,673,236.76
	Saving on Air Conditioning		8.86%
	Saving on Total Buildings		3.14%

Based on table IV.18 LCCA obtained savings due to the replacement of CFC refrigerant with HC refrigerant of Rp. 2,237,673,236.76 or 3.14% of the building value. The nature of the hydrocarbon refrigerant is that it does not damage the environment, thus replacing the current CFC refrigerant with a hydrocarbon refrigerant (HC) can improve one of the functions of air conditioning, which is an environmentally friendly function.

4.1.5 Foundation Creation and Evaluation Stage

In carrying out VE at the creation stage, make as many alternative foundations as possible as a substitute for the plan foundation (present design).

Table 4.5 Creative Ideas

No.	Alternative Foundation
1.	Chicken Claw Foundation (Slab with Concrete Pipe)
2.	Raft Foundation (Raft Foundation)
3.	Cobweb Construction (KSLL)
4.	Kaison Open
5.	Pneumatic Kaison
6.	Floating Kaison
7.	Steel Pile
8.	Steel-Concrete Composite Piles
9.	Spun Pile / Prestress Precast Concrete (Present Design)
10.	Precast Reinforced Concrete Piles
11.	Reinforced Concrete Pile Bore

The evaluation stage is carried out using a questionnaire to obtain expert validation and enter experts and using the Pairwise Comparison Matrix and Analytical Hierarchy Process (AHP) methods with the following results:

Table 4.6 Final Assessment of Foundation Work Experts

No	Type of Foundation Validated	Expert-1	Expert-2	Expert-3	Expert-4	Average
1	Precast Concrete Prestress Piles (present design)	9.505	8.512	6.716	8.140	8.218
2	Precast Reinforced Concrete Piles	9.432	6.305	8.075	8.324	8.034
3	Steel Pile	8.384	8.866	7.139	5.736	7.531
4	Composite Pile	8.821	6.298	7.283	6.184	7.146
5	Bore Pile	8.339	7.761	4.449	6.600	6.787

In table 4.6 it can be concluded that the precast concrete prestress pile foundation (present design) is the best choice. Thus the foundation study does not need to proceed to the development stage.

4.1.6 Stage of Creation, Evaluation, Development and Stage of Plastering Recommendation

The creative stage produces an alternative to the use of cement, sand or dry mix. The evaluation stage is carried out with validation from experts between cement-sand plaster with a thickness of 15 mm or using dry mix with an application thickness of 5-8 mm. The next evaluation stage uses the Pairwise Comparison Matrix and Analytical Hierarchy Process (AHP) methods.

Table 4.7 Final Assessment of Plastering and Finishing by Experts

No	Scope of Work	Resp-1	Resp-2	Resp-3	Resp-4	Resp-5	Resp-6	Resp-7	Resp-8	Average
1	Dry mix plaster and plaster	6.358	7.853	8.350	7.772	8.000	8.743	8.743	10.000	8.227
2	Plastering and plastering cement sand	8.089	7.867	7.120	6.957	7.429	8.257	8.257	8.000	7.747

Table 4.8 Plastering and Preliminary Design Work

Installation of 1 m² of plaster 1 SP : 4 PP 15 mm thick (PU28/2016 Part.4-A.4.4.2.4)						
Installation of 1 m² of plaster (PU28/2016 Part.4-A.4.4.2.27)						
A.	Man Power					
-	Worker	L.01	OH	0.500	95,973	47,986.50
-	Bricklayer	L.02	OH	0.250	117,076	29,269.00
-	Chief Bricklayer	L.03	OH	0.025	134,858	3,371.45
-	Foreman	L.04	OH	0.025	155,133	3,878.33
	Total Labor Wages (A)		OH	0.800		84,505.28
B.	INGREDIENTS					
-	Portland cement		kg	9.490	1,876	17,803.24
-	tide sand		m3	0.024	228,400	5,481.60
	Total Material Price (B)					23,284.84
C.	EQUIPMENT					
	Total Tool Price (C)					0.00
D.	Sum (A + B + C)					107,790.12
E.	Floor Factor					1.240
	Total D x E					133,659.74
F.	Overhead and Profit 10% (0.1 x D)					13,365.97
G.	Unit Price of Work (D + E)					147,025.67
I	Plastering and Acian Fee		M^2	19,916.67	147,025.67	**2,928,261,784**

Table 4.9 Plastering Work without Accurate Design Development

Installation of 1 m² of plaster without plaster with ready-to-use mortar (MSP) (PU28/2016 Part.4-A.4.4.2.1)						
Note: Plastering and plastering capacity is ± 4.5 m²/bag 50 kg/application thickness 0.75 mm						
A.	Man Power					
-	Worker	L.01	OH	0.300	95,973	28,791.90
-	Bricklayer	L.02	OH	0.150	117,076	17,561.40
-	Chief Bricklayer	L.03	OH	0.015	134,858	2,022.87
-	Foreman	L.04	OH	0.015	155,133	2,327.00
	Total Labor Wages (A)		OH	0.480		50,703.17
B.	INGREDIENTS					
-	MU-S150		kg	11.111	1,941	21,566.67
	Total Material Price (B)					21,566.67
C.	EQUIPMENT					
	Total Tool Price (C)					0.00
D.	Sum (A + B + C)					72,269.83
E.	Floor Factor					1.12
	Total D x E					80,942.21
E.	Overhead and Profit 10% (0.1 x D)					8,094.22
F.	Unit Price of Work (D + E)					80,364.05
G.	rounded up					**80,364**
I	Plastering costs as well as dry mix materials		M^2	19,916.67	80,364.00	**1,600,583,268**

Table 4.10 Plastering and Acian LCCA

No	Life Cycle 50 years Interest Rate 14%	Original Design With Sand Cement Plaster	VE Studi study Plaster with Dry Mix
1	Capital Cost	Rp. 2,928,261,784.3	Rp. 1,600,583,267.9
	Initial Cost	Rp. 2,928,261,784.3	Rp. 1,600,583,267.9
2	Annual Cost		
	Maintenance cost	Rp. 38,825,711.4	Rp. 11,761,944.6
	Total Annual Cost	Rp. 38,825,711.4	Rp. 11,761,944.6
3	Salvage Cost	Rp. 0.0	Rp. 0.0
	TOTAL PTRESENT VALUE	Rp. 2,967,087,495.7	Rp. 1,612,345,212.4
	LC Present value Saving		Rp. 1,354,742,283.3
	Saving against Plastering		45.66%
	Saving on total cost Building		1.90%

Based on the LCCA calculation, savings are obtained compared to the initial design of Rp.1,354,742,283.3 or 1.90% of the value of the building. There is a time saving of 40%. Based on the dry mix properties that use fly ash and other materials that can reduce the performance of plastering, the permeability of

plastering also increases the function of preventing seepage which can increase the durability of the walls and prevent moisture.

4.2 Implementation of Research and Analysis of VE Study Readiness Data at the Construction Center of the Ministry of Defense of the Republic of Indonesia

4.2.1 Introduction

The implementation of the research starts from identification, preparation of research instruments, in the form of questionnaires. Furthermore, the distribution of questionnaires, data processing using statistical questionnaire results. The research was carried out to assess the readiness to implement the VE study at the Construction Center of the Ministry of Defense of the Republic of Indonesia (Construction Center). This is important so that Construction Center can increase the readiness to implement the VE method. The results of statistical analysis will be obtained research findings.

4.2.2 Identification of Variables

Based on the literature study, seven main variables were determined as independent variables to obtain a description of the readiness to implement the VE study at the Construction Center as the dependent variable. The main variables are:

Y = Readiness to apply the VE study at the Indonesian Ministry of Defense Construction Center;
X1 = Availability of regulations on confidentiality at the Indonesian Ministry of Defense;
X2 = Availability of laws and regulations regarding the application of the VE method;
X3 = Availability of more detailed guidance on implementing the VE method;
X4 = Availability of human resources educated in Architecture, Civil, Mechanical, Electrical and Environmental Management (ASMET);
X5 = Availability of a competent VE team;
X6 = Availability of support from the Construction Center;
X7 = Availability of support from construction service providers.

Table 4.11 List of Variables

No	Variable	Reference
A	Independent Variable (Criteria for Readiness to Apply the VE Method)	
1	X1 = Availability of regulations on confidentiality at the Indonesian Ministry of Defense	Law No. 14 years. 2008 concerning Public Information; Regulation of the Minister of Defense of the Republic of Indonesia Number 17 of 2013 concerning Government Procurement of Goods and Services
2	X2 = Availability of laws and regulations regarding the application of VE studies;	NO 2 years. 2017 concerning Construction Services; Regulation of the Minister of Public Works and Public Housing No. 22 of 2018 concerning Guidelines for the Construction of State Buildings; Regulation of the Minister of Public Works and Public Housing Number: 06/PRT/M/2008 concerning development supervision,
3	X3 = Availability of more detailed guidance on implementing VE studies	Latief dan Untoro, 2009
4	X4 = Availability of ASMET educated human resources	Untoro, 2009
5	X5 = Availability of competent VE team	1. Hammersley, 2002, 2. Standar SAVE, 2007
6	X6 = Availability of support from Puskon	Asiyanto, 2005
7	Dependent variable	Asiyanto, 2005
B	Y = Readiness of Application of VE Method	

The dependent and independent variables are to be able to fulfill the regression equation:

$$Y = a + b.X1 + c.X2 + d.X3 + e.X4 + d.X5 + e.X6 + f.X7$$

4.2.3 Data Collection and Processing

Data from survey results using a questionnaire using a Likert scale. Data from the survey results which are ordinal data are transformed into interval data using Microsoft Excel. Furthermore, validity and reliability tests were carried out using the help of the SPSS program.

Table 4.12 Average Value of Validated and Reliable Data

Resp	X1	X2	X3	X4	X5	X6	X7	Y
1	2.67	2.66	2.01	2.26	1.00	1.24	1.40	1.80
2	1.46	2.25	1.00	2.26	1.00	2.82	2.59	1.00
3	1.46	2.25	1.66	2.80	1.80	1.00	1.00	1.00
4	1.00	1.00	2.29	1.39	1.00	2.04	1.87	1.00
5	2.27	1.00	2.29	1.39	1.00	2.04	1.87	1.00
6	1.46	2.40	2.77	2.26	1.00	2.71	2.59	1.80
7	3.16	2.23	1.00	3.71	2.48	3.68	3.31	1.80
8	1.46	1.93	1.00	1.39	1.67	2.04	1.74	1.00
9	1.00	2.25	1.66	2.80	1.80	2.04	1.00	1.00
10	2.26	3.36	3.03	2.80	1.80	3.15	2.43	2.67
11	1.86	2.25	1.62	1.87	1.80	2.38	1.40	1.00
12	1.86	2.37	1.62	1.78	3.04	2.47	2.51	1.80
13	2.67	1.60	2.30	1.78	2.48	2.38	1.87	1.87
14	2.26	3.04	3.77	2.80	2.48	3.15	2.90	2.67
15	2.27	1.16	2.77	1.39	1.80	1.98	1.87	1.00
16	1.87	1.79	2.94	2.02	2.48	3.15	3.34	1.80
17	1.86	2.25	1.00	2.69	1.00	2.82	2.59	1.80
18	2.67	3.40	3.77	3.71	1.67	3.68	2.05	2.67
19	1.86	2.59	2.77	1.87	3.04	2.71	3.34	1.80
20	1.46	2.25	1.66	2.80	2.48	1.00	1.00	1.00

Tabel 4.13 Responden

Resp	Education	Work Experience (Years)	Specialization Bachelor Degree	Specialization Magister
1	Bachelor	29	Civil Engineering	
2	Magister	19	Etc	Magister of Defense
3	Magister	20	Architect	Magister of Defense
4	Bachelor	17	Computer	
5	Magister	11	Civil Engineering	Civil Engineering
6	Bachelor	34	other	
7	Magister	22	Civil Engineering	Construction Management
8	Senior High School	19		
9	Magister	30	T Architecture	Magister Management
10	Bachelor	20	other	
11	Senior High School	29		
12	Senior High School	33		
13	Senior High School	30		
14	Bachelor	27	other	
15	Senior High School	24		
16	Senior High School	33		
17	Senior High School	25		
18	Bachelor	16	Q. Architecture	
19	Magister	21	Q. Architecture	other
20	Bachelor	20	other	

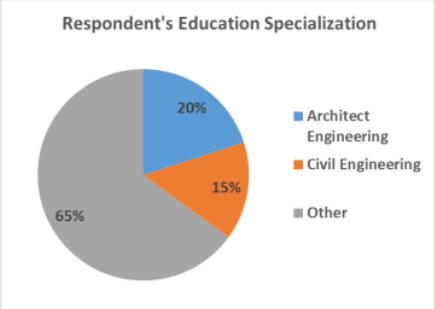


Figure 4.6 Respondents Education Department

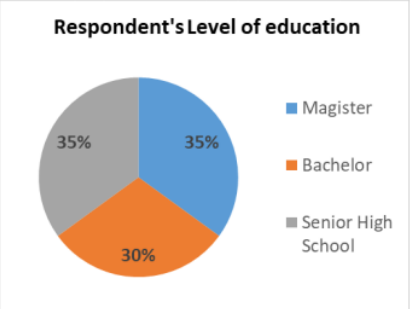


Figure 4.7 Respondent Education Strata

V.4.2.4 Descriptive Analysis

The results of descriptive analysis produce mean, variance, mode, and standard deviation as shown in table 4.14

Table 4.14 Descriptive Analysis

	Regulations On Confidentiality	Laws And Regulations Regarding The Application Of The VE Method	More Detailed Guidance On Implementing The VE Method	ASMET Educated Human Resources	Competent VE Team	Support From The Construction Center	Support From Construction Service Providers	=Readiness to apply the VE study at the Construction Center
Mean	1.8190	2.2015	2.1465	2.2885	1.8410	2.4240	2.1335	1.5740
Median	1.7850	2.2500	2.1500	2.2600	1.8000	2.4250	1.9600	1.8000
Mode	1.31[a]	2.25	1.00	2.80	1.00	2.04	1.87	1.00
Std. Deviation	0.46210	0.66894	0.87219	0.71384	0.69689	0.77676	0.76461	0.60759

V.4.2.5 Multiple Regression Analysis

Multiple Linear Regression Analysis using Enter, Backward, Forward, Stepwise and Remove methods. Based on the analysis and testing, it is proven that using the Stepwise and Forward method produces the best linear regression equation, namely:

Y = - 0.959 + 0.284 X1 + 0.457 X2 + 0.239 X3+ 0.217 X4 …….. (4.1)

Y = Readiness to apply the VE study at the Indonesian Ministry of Defense Construction Center;
X1 = Availability of regulations on confidentiality at the Indonesian Ministry of Defense;
X2 = Availability of laws and regulations regarding the application of the VE method;
X3 = Availability of more detailed guidance on implementing the VE method;
X4 = Availability of human resources educated in Architecture, Civil, Mechanical, Electrical and Environmental Management (ASMET);
X5 = Availability of a competent VE team;
X6 = Availability of support from the Construction Center;
X7 = Availability of support from construction service providers
With Adjusted R Square = 0.842

V.4.2.6 Frequency Distribution Analysis

The readiness of the Construction Center in implementing the VE study ranged from undecided to undecided – ready.

V.4.2. Correlation Analysis

Based on the correlation analysis of equation 4.1 variables X1, X2, X3 and X4 have correlation coefficients of 0.569, 0.714, 0.626 and 0.535, respectively.

V. CONCLUSION, LIMITATIONS AND SUGGESTIONS

5.1 Conclusion

a. Based on the discussion of the implementation of the 6 stages of the VE study on air conditioning and plastering, there was a savings of Rp.1,354,742,283.3 or 1.90% of the value of the building. The use of dry mix plastering results in a 40% savings in plastering implementation time compared to sand cement plastering and reduces the permeability of the stucco which can increase the function of preventing excessive seepage so that the walls are durable and not damp. The use of hydro carbon refrigerant in air conditioning work has also been shown to increase the environmental friendly function;

b. Based on the descriptive analysis of Readiness to implement the VE Study at the Ministry of Defense Construction Center, the distribution was normal with Mean = 1.5740, Median = 1.8000, Mode = 1.00 and Sandard. Deviation = 0.60759;

c. Based on the analysis and testing, it is proven that using the Stepwise and Forward method produces the best linear regression equation, namely:

Y = - 0.959 + 0.284 X1 + 0.457 X2 + 0.239 X3+ 0.217 X4 …….. (4.1)

Y = Readiness to apply the VE study at the Indonesian Ministry of Defense Construction Center;
X1 = Availability of regulations on confidentiality at the Indonesian Ministry of Defense;
X2 = Availability of laws and regulations regarding the application of the VE method;

X3 = Availability of more detailed guidance on implementing the VE method;
X4 = Availability of human resources educated in Architecture, Civil, Mechanical, Electrical and Environmental Management (ASMET);
X5 = Availability of a competent VE Team;
X6 = Availability of support from the Construction Center;
X7 = Availability of support from construction service providers
Adjusted R Square = 0.842

d. Based on the Frequency Distribution Analysis, Puskon's readiness to carry out the VE study ranged from undecided to undecided – ready.

5.2 Limitations

Limitations / Constraints on understanding of confidentiality, understanding of the VE Study, time available to carry out data collection and limited number of respondents have become obstacles to obtaining complete data

5.3 Suggestions

a. Suggestions for Completion of Research Implementation, among others, in the implementation of data collection involving outside the Indonesian Ministry of Defense and the TNI, screening needs to be carried out, signing an integrity pact, and presenting data selectively. The need for socialization of the VE method and involving experts/respondents who do not spread and involve retired TNI or retired ASN who meet the requirements;

b. Suggestions for Improvement of Advanced Research. Noting that the research results are not perfect and to get a better outcome, further research can be suggested, including:

1) Implementing Confidential Data and Information Security Policies at the Indonesian Ministry of Defense and the Indonesian Armed Forces in Supporting Efficiency Improvement and Optimization of Defen Facilities and Infrastructure Development Functions with Case Studies of the Application of the VE Method at the Ministry of Defense of the Republic of Indonesia;

2) Implementation of State Building Development Policies in Supporting Efficiency Improvement and Optimization of Defense Fac es and Infrastructure Development Functions with Case Studies of the Application of the VE Method at the Ministry of Defense of the Republic of Indonesia;

3) Efforts to Improve Quality-Oriented Development Faced with a Defense Secrecy Situation;

4) Improvement of Quality Oriented Development Culture Faced with Military Operation Culture

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