OPERATIONAL & MAINTENANCE COST AND REVENUE ANALYSIS ON THE CONCEPTUAL DESIGN.OK

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OPERATIONAL & MAINTENANCE COST AND REVENUE ANALYSIS ON THE CONCEPTUAL DESIGN OF BATUAMPAR CARGO PORT SYSTEMS OF BATAM CITY USING VALUE ENGINEERING APPROACH

[1]Edi Indera, [2]Yelna Yuristiary, [3]Chablullah Wibisono, [4]Tri Nadya Pratiwi
ediindera@gmail.com,yelnaccmd@gmail.com, chablullahwibisono@gmail.com
ndyapratiwi@gmail.com
[1, 2, 4]Faculty of Engineering, Department of Civil Engineering, Batam University,[3]Professor of the Faculty of Economics at Batam University, Riau Islands, Indonesia
*Email correspondence: chablullahwibisono@gmail.com

ABSTRACT

Batu Ampar Batam Port is a large port; besides serving general goods, it also serves loading and unloading containers. The volume of goods shipments through the Batu Ampar Port continues to increase from year to year. Besides, its use is also expected to increase the number of loads that can be handled. There needs to be an increase in the addition of functions and investment analysis for the long term to lure investors to come. Based on this phenomenon, research with the title Operational & Maintenance Cost and Revenue Analysis on the Conceptual Design of the Batu Ampar Batam Cargo Port System with a Value Engineering Approach needs to be carried out. Before conducting a conceptual design, a project feasibility study is required to see an investment's feasibility. This study aims to analyze the feasibility of infrastructure using the Value Engineering method by considering the components of container terminals, cargo building, dry bulk, breakbulk, liquid measurement, passenger ports, railway systems, and income from 2018-2068. The cost analysis was obtained from the results of benchmarking to several countries.

Keywords: Batu Ampar Harbor, Value Engineering, Cost Component, OM & Revenue

I. BACKGROUND

The mode of sea transportation in Batam city is still under investment because investors have not yet seen the maximum potential of existing port infrastructure (Suharto, Kun, 2017). For this reason, it is necessary to have research related to investment feasibility analysis where operational & maintenance cost components (operating and maintenance costs) and conceptual revenue for port system design are needed. Based on this phenomenon, research with the title Operational & Maintenance Cost and Revenue Analysis on the Conceptual Design of a Cargo Port System with a Value Engineering Approach is necessary. One of the largest cargo ports in Batam City, Batu Ampar Port, is currently choosing many people in using transportation services because it can transport large quantities of goods and travel long distances. The flow of sea traffic at Batu Ampar Port is increasing. This can be seen from the growth of loading and unloading at the Port from year to year. This sea traffic flow condition is inseparable from the improvement of services, supporting facilities, and infrastructure at Batu Ampar Port, Batam City.

1.1 Purpose and Objectives

This research is intended to analyze the results of Operational & Maintenance Cost and Revenue on the conceptual design of the Batu Ampar cargo port system in Batam City with a value engineering approach and to know the results of Benchmarking Operational & Maintenance Cost and Revenue on the conceptual design of the Batu Ampar cargo port system in Batam City to several countries. In this world.

1.2 Problem Formulation

Based on the above discussion, the problem formulation is only on analyzing future investments using value engineering at OM Cost and Revenue conceptual design and benchmarking from several countries.

. 1.3 Research Benefits

The benefit of this research is that it can become a benchmark in financing the implementation of sea transportation, especially the Batu Ampar Unloading Port, Batam City.

II. THEORETICAL BASIS

In an analysis, it is necessary to understand the supporting theory in order to obtain maximum results. It is necessary to have a theoretical basis for determining the specifications that will become a reference in analyzing the Operational & Maintenance Cost and Conceptual Revenue design of the Batu Ampar cargo port system in Batam City using the Value approach method. Engineering and Benchmarking against several countries in the world.

Value Engineering

Value Engineering is a method of analysis to optimize cost efficiency, which initially can increase costs in a budget. After a value engineering has been carried out, it produces a cost-efficiency result while adhering to the principle of not eliminating the quality, function, benefits, and aesthetics of an element of the work being performed in Value Engineering analysis (James, 2014).

Net Present Value (NPV)

The Net Present Value method is one of five financial feasibility that can be done to determine the investment feasibility (Björnsdóttir, Anna Regína, 2010). Here is the NPV formula (Park, 2002):

$$\text{NPV (I)} = \frac{A^0}{(1+i)^0} + \frac{A^1}{(1+i)^1} + \ldots\ldots\ldots$$

$$\sum_{n=0}^{N} \frac{An}{(1+i)^n}$$

Where :

An = Net cash flow at the end of the nth period

i = MARR (Minimum Attractive Rate of Return)

N = age of the project According to (Park 2002), the rules of the NPV decision are:

If NPV (i)> 0, the investment is accepted

If NPV (i) = 0 then investment is considered

If NPV (i) <0, the investment is rejected

Operational & Maintenance Cost

Operational Cost is all the company's sacrifices to fund the company's operations to achieve the goals a company wants to achieve (landasanteori.com). Operational & maintenance costs, with their consumable nature, are generally incurred repeatedly. Therefore, maintenance costs are often referred to as recurrent costs (Nurrohman, 2014).

Revenue

Revenue is the result obtained on a project, derived from the final project value (salvage value) and the annual valueobtained during a project's working life.

III. RESEARCH METHODS

Approach and Type of Research

In scientific research, research methodology and methodology are first understood.

Research Flow

This research has a plot, as shown in the picture:

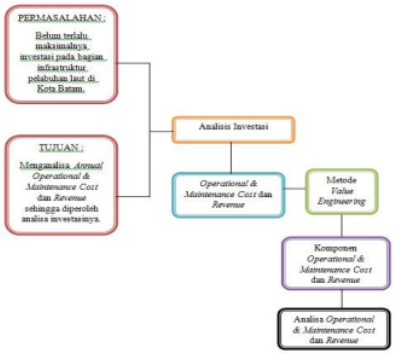

Figure.1. Research Flowchart

Research Framework

From the description above, a diagram of the research framework can be made, as shown below:

Research is a study method carried out by a person through careful and perfect investigation of a problem to obtain the correct solution to the problem. In researching to obtain facts that are believed to be accurate, the research method is essential because research can be judged valid or not based on the provisions for using the research method. The method used in this research is a qualitative research method on Benchmarking Operational & Maintenance Cost and Revenue port systems that have been developed in Batam with those that have been developed in several countries in the world. Operational &

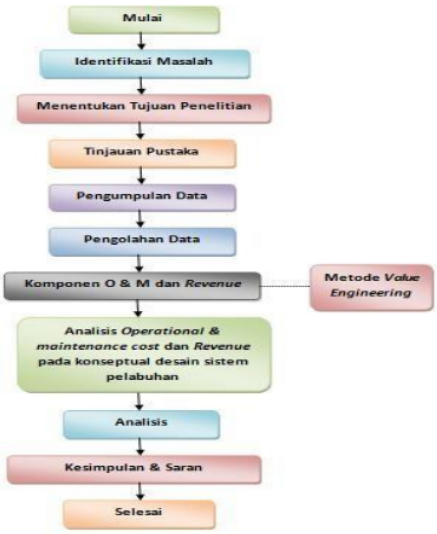

Figure.2. Research Framework

IV. DATA ANALYSIS

Benchmarking Selection Analysis

Specifications of the components & functions of seaports for each Port vary. Benchmarking of the port system is carried out by referring to 6 seaports globally, namely, Port Klang Malaysia, Bangkok Port Thailand, Dalian Port China, Nelson Port New Zealand, Chennai Port India, Vancouver Port Canada.

V. DISCUSSION

OM Cost Analysis. OM Cost (Operational & Maintenance Costs) is fundamental in analyzing the investment feasibility of a project. Especially for Port Cargo Systems. Operational & maintenance costs can affect the performance or activities at the Port**.**

Table.1. **OM Fees Of Several Countries**

PORT	COMPONENT	CAPACITY	2018 O&M COST ($)

KLANG PORT MALAYSIA (Annual Report 2015)	CONTAINER TERMINAL CARGO BUILDING DRY BULK	17.6 million TEUs 8.6 million tons 8.8 million tons	3,984,155.33 1,344,567.03 194,224
DALIAN PORT CHINA (Annual Report 2015)	BREAK BULK LIQUID BULK CONTAINER TERMINAL PEL. PASSENGER	20 million tons 25.1 million tons 2.6 million TEUs 7.5 million vehicles	27,583,301 23,516,797 22,683,584 1,641,577
BANGKOK PORTTHAILAND (Annual Report 2016)	CARGO BUILDING	1.3 million TEUs	1,891.39
VANCOUVER CANADA (Annual Report 2015)	CONTAINER TERMINAL	185 thousand TEUs	92,903.30
NELSON PORT NEW ZEALAND (Annual Report 2016)	CONTAINER TERMINAL BREAK BULK	220,048 TEUs 2.4 million Tonnes	3,492,879 456,221
CHENNAI PORT INDIA (Annual Report 2016)	RAILWAY BREAK BULK CONTAINER TERMINAL CARGO BUILDING	2.75 kilometers 640 thousand tons 8 million TEUs 20 million tons	1,047,378 234,024.73 1,018,478 437,783

Source: Author's Process (2017)

The 2018 OM costs are obtained from the conversion results of the year the Annual Report is published for each country by drawing a comparison using the Cost Construction Index (CCI) or the Construction Expensive Index (IKK) of countries. Their components are selected with the Indonesian IKK. Then we get the price of Indonesia in the year according to the Annual Report of each country. The inflation needs to be calculated again to get the price in 2018 using the BI Rate for the last six years then converted into Rupiah currency. From some of the components above, we can apply them by making a capacity plan. The capacity plan is obtained from several related sources of Cargo Port in Batam for conceptual design at Batam City Port, as follows:

Table.2. OM Component Capacity Plan

COMPONENT	CAPACITY PLAN FOR BATAM	UNIT VOLUME
CONTAINER TERMINAL	1.5 million	TEUs
CARGO BUILDING	396 thousand	Tons
DRY BULK	750 thousand	Tons
BREAK BULK	250 thousand	Tons
LIQUID BULK	2.2 million	Tons
PASSENGER PORT	11.6 million	Vehicles
RAILWAY SYSTEM	2.00	Kilometers

Source: Author's Process (2017)

O&M Plan Cost at Batam Cargo Port

The planning cost is obtained from the comparison between the capacity and Cost of benchmarking several foreign ports with the conceptual design capacity of the Batam port, using the benchmarking costs for each component multiplied by the planned capacity in Batam and then divided by the capacity at foreign ports.

O&M Benchmarking Results of Several Components In looking for benchmarking results, we must first know the average BI Rate in the last six years, namely in 2012 - 2017, then the results are:

Table.3. OM Plan Costs

COMPONENT	CAPACITY PLAN	2018 PLAN FEE (Rp)
Container Terminal	1,500,000 TEUs	5,486,080,109.94
Cargo Building	396,000 tons	3,818,552,836.37
Dry Bulk	750,000 tons	267,441,486.34
Break Bulk	250,000 tons	721,282,948.27
Liquid Bulk	2,200,000 tons	33,302,215.46
Passenger Port	11.600.000 vehicles	41,020,902,298.78
Railway System	2,00 kilometers	11,561,185,655.31

Source: Author's Process (2018)

Table 4: BI Rate 2012-2017 (%)

	2012	2013	2014	2015	2016	2017
JANUARY	6	5.75	7.5	7.75	7.25	4.75
FEBRUARY	5.75	5.75	7.5	7.5	7	4.75
MARCH	5.75	5.75	7.5	7.5	6.75	4.75
APRIL	5.75	5.75	7.5	7.5	6.75	4.75
MAY	5.75	5.75	7.5	7.5	6.75	4.75
JUNE	5.75	6	7.5	7.5	6.5	4.75
JULY	5.75	6.5	7.5	7.5	6.5	4.75
AUGUST	5.75	7	7.5	7.5	5.25	4.5
SEPTEMBER	5.75	7.25	7.5	7.5	5	4.25
OCTOBER	5.75	7.25	7.5	7.5	4.75	4.75
NOVEMBER	5.75	7.5	7.75	7.5	4.75	4.75

DECEMBER	5.75	7.5	7.75	7.5	4.75	4.75
CUMULATIVE	**5.77**	**6.48**	**7.54**	**7.52**	**6.00**	**4.69**
AVERAGE						**6.11**

Source: Author's Process (2018)

The Batu Ampar Port's planned capacity is 1.5 million TEUs, so the benchmarking results in 2018 were IDR 5,486,080,109.94.

Table .5. OM Container Terminal

YEAR	COTTON	PLAN O&M COSTS
2018	1,500,000.00	5,486,080,109.94
2068	1,500,000.00	106,433,384,297.89

OM Cargo Building In, the selection of benchmarking OM Cargo Building, was selected according to the conditions of the Port of Batu Ampar, namely Bangkok Port Thailand with a capacity of 1.3 million tons and a cost of Rp. 12,535,653,250.71 - Then, from the analysis of several sources and conditions of the Port, the planned capacity for the Port is obtained. Batu Ampar amounted to 396 thousand tons, so the benchmarking results in 2018 were Rp. 3,818,552,836.37.

Table .6. OM Cargo building

YEAR	CAPACITY	PLAN O&M COSTS
2018	396,000	3,818,552,836.37
2068	396,000	74,082,312,571.22

OM Dry Bulk. In the selection of benchmarking, OM Dry Bulk was chosen according to the Batu Ampar Port conditions, namely Port Klang Malaysia, with a capacity of 8.8 million tons and a cost of Rp. 3,137,980,106.42, -. Then from the results of the analysis of several sources and conditions of the Port, it was found that the planned capacity for the Batu Ampar Port was 750 thousand tons, so the results of 2018 benchmarking were Rp. 267,441,486.34.

Table .7. OM Dry Bulk

YEAR	CAPACITY	PLAN O&M COSTS
2018	750,000	267,441,486.34
2068	750,000	5,188,532,052.52

OM Break Bulk In the benchmarking selection, OM Break Bulk was chosen according to the conditions of the Port of Batu Ampar, namely Nelson Port New Zealand, with a capacity of 2.4 million tons and a cost of Rp. 6,924,316,303.36, -. Then from the results of the analysis of several sources and conditions of the Port, it was found that the planned capacity for the Batu Ampar Port was 250 thousand tons, so the benchmarking results in 2018 were IDR 721,282,948.27.

Table .8. OM Break Bulk

YEAR	CAPACITY	PLAN O&M COSTS
2018	250,000	721,282,948.27
2068	250,000	13,993,340,177.68

OM Liquid Bulk In the selection of OM Liquid Bulk benchmarking, it was chosen according to the Batu Ampar Port conditions, namely Dalian Port China, with a capacity of 25.1 million tons and a cost of Rp. 379,948,003,674.23, -. Several sources and conditions of the Port obtained the planned capacity for the Batu Ampar Port of 2.2 million tons, so the benchmarking results in 2018 were IDR 33,302,215,461.49.

Table.9.OM Liquid Bulk

YEAR	CAPACITY	PLAN O&M COSTS
2018	2,200,000	33,302,215,461.49
2068	2,200,000	646,083,802,123.64

OM of Passenger Port In the selection of OM benchmarking for Passenger Port selected according to the condition of Batu Ampar Port, namely Dalian Port China with a capacity of 7.5 million vehicles and a cost of IDR 26,522,135,106.97, several sources and conditions of the Port, the planned capacity for Batu Ampar Port was obtained. Amounting to 11.6 million vehicles, the benchmarking results were obtained in 2018 of IDR 41,020,902,298.78, -.

Table.10.OM Passenger Ports

YEAR	CAPACITY	PLAN O&M COSTS
2018	11,600,000	41,020,902,298.78
2068	11,600,000	795,831,152,866.96

OM Railway System In the benchmarking selection, the OM Railway System was chosen according to the Batu Ampar Port conditions, namely Chennai Port India, with a capacity of 2.75 km and a cost of Rp. 15,896,630,276.05, -. Then from the results of the analysis of several sources and conditions of the Port, the Batu Ampar Port's planned capacity is 2.0 km, so the results of 2018 benchmarking were Rp. 11,561,185,655.31

Table.11.OM Railway System

YEAR	CAPACITY	PLAN O&M COSTS
2018	2.00	11,561,185,655.31
2068	2.00	224,294,230,330.65

Revenue Analysis

In a conceptual design, revenue is needed as the number one benchmark to see a project's success. Therefore, the revenue of a conceptual design in the long term for the next few years must be known.

Table.12. Revenue Fees of Several Countries

PORT	COMPONENT	CAPACITY	2018 Revenue COSTS ($)
KLANG PORT MALAYSIA (Annual Report 2015)	CONTAINER TERMINAL CARGO BUILDING DRY BULK	17.6million TEUs 8.6 million tons 8.8 million tons	4,089,296.7 1,463,000 398,000
DALIAN PORT CHINA (Annual Report 2015)	BREAK BULK LIQUID BULK CONTAINER TERMINAL PEL. PASSENGER	20 million tons 25.1 million tons 2.6 million TEUs 7.5 million vehicles	36,149,240 30,756,323.43 29,233,910 2,814,484
BANGKOK PORT THAILAND (Annual Report 2016)	CARGO BUILDING	1.3 million TEUs	721,000
OUVER CANADA (Annual Report 2015)	CONTAINER TERMINAL	185 thousand TEUs	109,186.16
NELSON PORT NEW ZEALAND (Annual Report 2016)	CONTAINER TERMINAL BREAK BULK	220,048 TEUs 2.4 million Tonnes	4,080,629.41 505,454.36

This 2018 Revenue Cost is obtained from the conversion results of the year the Annual Report is published for each country by drawing it, by comparison, using the Cost Construction Index (CCI) or the Construction Expensive Index (IKK) of countries. Their components are selected with the Indonesian IKK. Then we get the price of Indonesia in the year according to the Annual Report of each country. The inflation needs to be calculated again to get the price in 2018 using the BI Rate for the last six years then converted into Rupiah currency. Of the several components above, we can apply them by making a capacity plan. The capacity plan is obtained from several related sources of Cargo Port in Batam for conceptual design at Batam City Port, as follows:

Table.13. Revenue Plan Component Capacity

COMPONENT	CAPACITY PLAN FOR BATAM	UNIT VOLUME
CONTAINER TERMINAL	1.5 million	TEUs
CARGO BUILDING	396 thousand	Tons
DRY BULK	750 thousand	Tons
BREAK BULK	250 thousand	Tons
LIQUID BULK	2.2 million	Tons
PASSENGER PORT	11.6 million	Vehicles
RAILWAY SYSTEM	2.00	Kilometers

Source: Author's Process (2018)

Revenue Plan Costs at Batam Cargo Port

The planning cost is obtained from comparing the capacity and Cost of benchmarking several foreign ports with the conceptual design capacity plan in Batam port. Then you get:

Table.14. Revenue Plan Fees

COMPONENT	CAPACITY PLAN	2018 PLAN FEE (Rp)
Container Terminal	1,500,000 TEUs	5,897,782,237.18
Cargo Building	396,000 tons	4,384,043,657.38
Dry Bulk	750,000 tons	611,096,292.42
Break Bulk	250,000 tons	799,120,621.93
Liquid Bulk	2,200,000 tons	46,833,396.59
Passenger Port	11.600.000 vehicles	75,625,417,883.66
Railway System	2,00 kilometers	18,139,818,419.41

Revenue Container Terminal

In the selection of benchmarking, the Revenue Container Terminal was chosen according to the Batu Ampar Port conditions, namely Port Klang Malaysia, with a capacity of 17.6 million TEUs and a cost of Rp. 69,200,644,916.22, -. Then from the results of the analysis of several sources and conditions of the Port, the Batu Ampar Port's planned capacity is 1.5 million TEUs, so the results of 2018 benchmarking were Rp. 5,897,782,237.18.

Revenue Dry Bulk

In the selection of benchmarking, Dry Bulk Revenue was chosen according to the Batu Ampar Port conditions, namely Bangkok Port Thailand, with a capacity of 8.8 million tons and a cost of Rp 7,170,196,497.76 -. Then from the results of the Port's analysis and conditions, the planned capacity for the Batu Ampar Port is 1,500,000.00, so the results of the 2018 Revenue costs are Rp. 5.89, .782,237.18

Table.15. Revenue Container Terminal

TAHUN	KAPASITAS	BIAYA REVENUE RENCANA
2018	1,500,000.00	5,897,782,237.18
2068	1,500,000.00	114,420,662,982.62

Revenue Cargo Building

In the benchmarking selection, the Revenue Cargo Building was chosen according to the Batu Ampar Port conditions, namely Bangkok Port Thailand, with a capacity of 1.3 million tons and a cost of Rp. 14,392,062,511.61, -. Then from the results of the analysis of several sources and conditions of the Port, it was found that the planned capacity for the Batu Ampar Port was 396 thousand tons, so the results of 2018 benchmarking were IDR 4,384,043,657.38.

Table.16. Revenue Cargo Building

TAHUN	KAPASITAS	BIAYA REVENUE RENCANA
2018	396,000	4,384,043,657.38
2068	396,000	85,053,188,071.33

By the Batu Ampar Port conditions, namely Port Klang Malaysia with a capacity of 17.6 million TEUs and a cost of IDR 69,200,644,916.22, -. Then, from the analysis of several sources and port conditions, the planned capacity for the Batu Ampar Port is 1.5

Revenue Dry Bulk

In the selection of benchmarking, Dry Bulk Revenue was chosen according to the Batu Ampar Port conditions, namely Bangkok Port Thailand, with a capacity of 8.8 million tons and a cost of Rp 7,170,196,497.76 -. Then from the results of the analysis of several sources and conditions of the Port, the planned capacity for the Port of Batu Ampar is 750 thousand tons, so the results of 2018 benchmarking were Rp. 611,096,292.42, -.

Table.17. Revenue Dry Bulk

YEAR	CAPACITY	PLAN REVENUE COSTS
2018	750,000	611,096,292.42
2068	750,000	11,855,650,160.23

Revenue Break Bulk

In the selection of benchmarking, Revenue Break Bulk was chosen according to the Batu Ampar Port conditions, namely Nelson Port New Zealand, with a capacity of 2.4 million tons and a cost of Rp 7,671,557,970.56 -. Then from the results of the analysis of several sources and conditions of the Port, it was found that the planned capacity for the Batu Ampar Port was 250 thousand tons, so the results of 2018 benchmarking were Rp. 799,120,621.93.

Table.18. Revenue Break Bulk

YEAR	CAPACITY	PLAN REVENUE COSTS
2018	250,000	799,120,621.93
2068	250,000	15,503,439,714.73

Revenue Liquid Bulk

In the selection of benchmarking, Liquid Bulk Revenue was selected according to the Batu Ampar Port conditions, namely the Dalian Port China, with a capacity of 25.1 million tons and a cost of Rp. 534,326,479,273.82. Batu Ampar amounted to 2.2 million tons, so the benchmarking results in 2018 were IDR 46,833,396,589.74.

Table.19. Revenue Liquid Bulk

YEAR	CAPACITY	PLAN REVENUE COSTS
2018	2,200,000	46,833,396,589.74
2068	2,200,000	908,597,176,366.70

Passenger Port Revenue

In the benchmarking selection, the Passenger Port Revenue was chosen according to the Batu Ampar Port conditions, namely Dalian Port China, with a capacity of 7.5 million vehicles and a cost of Rp. 48,895,744,321.33, -. Then from the results of the analysis of several sources and conditions of the

Port, it was found that the planned capacity for the Batu Ampar Port was 11.6 million vehicles, so the results of 2018 benchmarking were IDR 75,625,417,883.66, -.

Table .20. Passenger Port Revenue

YEAR	CAPACITY	PLAN REVENUE COSTS
2018	11,600,000	75,625,417,883.66
2068	11,600,000	1,467,180,391,645.99

Revenue Railway System

In the benchmarking selection, the Revenue Railway System was chosen according to the Batu Ampar Port conditions, namely Chennai Port India, with a capacity of 2.75 km and a cost of Rp. 24,942,250,326.69, -. Then from the results of the analysis of several sources and conditions of the Port, the Batu Ampar Port's planned capacity was 2.00 km, so the results of 2018 benchmarking were Rp. 18,139,818,419.41, -

Table.21. Revenue Railway System

TAHUN	KAPASITAS	BIAYA REVENUE RENCANA
2018	2.00	18,139,818,419.41
2068	2.00	351,923,819,236.57

Financial Feasibility Analysis

Based on the 12 tables that have been compiled, cash flow is obtained by accumulating OM Cost and Revenue Cost with the formula: Cash Flow = Revenue - OM Cost. The OM costs are operational costs for container terminals, cargo building, dry bulk, breakbulk, liquid bulk, ports. Passenger, railway system, and revenue fees in the container terminal, cargo building, dry bulk, breakbulk, liquid bulk, passenger port, railway system. Before the NPV (Present Net Value) calculation is carried out, the authors first analyze the cash flow of each scheme so that the total annual expenditure and income from the project are known, as follows:

Table.22. Cash Flow

TAHUN	O&M	REVENUE	CASHFLOW
2018	13,443,557,564,656.20	13,493,091,946,797.30	49,534,382,141.13
2068	1,641,612,524,089.92	2,602,610,508,941.60	960,997,984,851.69

So the NPV results are obtained using the excel formula [= NPV (6.11%, CASHFLOW! D3: D5 3)] which is IDR 2,380,787,380,263.40 using an average BI Rate of 6.11%, or it can be said that it is feasible for a conceptual port system design.

VI. CONCLUSION

a. The functional components added to Batu Ampar port are container terminal, cargo building, dry bulk, breakbulk, liquid bulk, passenger port, railway system.
b. The OM and revenue costs include the container terminal, cargo building, dry bulk, breakbulk, liquid bulk, passenger port, and railway system.
c. The result of calculating the NPV value of port cash flow in 2018 with a bank interest of 6.11% is IDR 2,380,787,380,263.40, so it can be concluded that this infrastructure is financially possible to implement.

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