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Financial Studies of The Development Project of Belawan Access Channel at PT. Pelindo I (Persero)

Listiani Nurul Huda
Department of Industrial Engineering
Engineering Faculty of the University of North Sumatera
Medan, Indonesia
lnurulh@gmail.com

***Abstrak*—Geographical condition of Indonesia that is dominated by sea led Indonesia to desperate need of the sea transportation management to meet its operational needs. PT. Pelindo I is a company that has the authority to manage the port in North Sumatra and its surrounding areas. Belawan's current access channel depth is between -7 s / d -9 mLWS. Ships that can directly enter the port area is a vessel with a draft of (hull) by 8 meters, while the larger vessels have to wait for high tide. Meanwhile, the ASEAN Economic Community policy and has been implemented since December 2015. Thus the deepening of the access channel to accommodate larger ships in order to expedite the process of marine transport is necessary. The purpose of this study was to assess the financial feasibility of the port plot development investments and facilities in the Port of Belawan and BICT. A financial review conducted by the parameter IRR and PI. Economic benefit analysis was also conducted to analyze the differences in the conditions 'project' and without the project. Having obtained the value of benefits and costs of economic and financial investment, a sensitivity test is carried out to test the sensitivity of investment to the uncertainty. The results of the analysis of the economic benefits of providing value EIRRs of 23.04% and PI worth of 3.83 with a discount factor of 12%. The results of the financial analysis of investment with the level of discount factor of 15% was obtained, namely 31.01% IRR and PI of 2.75, which means the investment is feasible.**

Keywords—Ports of Belawan; BICT; Investment Criteria; Sensitivity Analysis; Financials

I. INTRODUCTION

PT. Pelindo I is a company that is authorized to manage the port in North Sumatera and the surrounding area. Some of of them are the Port of Belawan and BICT (Belawan International Container Terminal) that are using the same access channel that is Belawan Access Channel. The current depth of the access channel is ranged between -7 s / d -9 mLWS (minus seven s / d minus nine meters Lower Water Spring) in the the lowest state and the highest height of the tide is 3.41 meters [1]. This depth can only accommodate ships with a draft of 8 meters or smaller. While the ship with a draft greater than 8 meters had to wait for ocean tides that are only available at the most 12 hours in a day [2].

It is even more alarming because in December 2015, the AEC policy that frees import duties for countries that are members of ASEAN has been accomplished. This policy will make the price of imported products be approximately the same or even cheaper than local products. These conditions will make local products less competitive than imported products and will lead to reduced levels of the Indonesian economy. Moreover, the condition of Indonesian domestic marine logistics costs are relatively high compare to international maritime logistics costs [3]. The cost comparison of Indonesian and international maritime logistics shown in Figure 1.

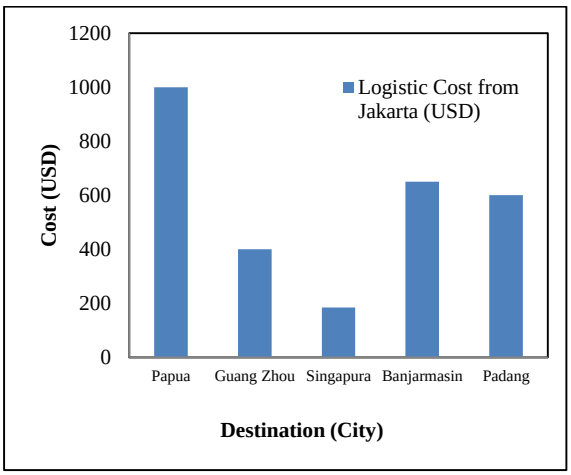

Figure 1. Marine Logistics Costs

From Figure 1 we can see that the cost of logistics from Jakarta to Padang which were located much closer is much more expensive than the Jakarta to Guang Zhou which is located in China. The cause of this problem one of them is the limited depth of the port access channel in Indonesia, which average less than 9 m-LWS and can only accommodate small boats. As has been demonstrated in previous studies [4] and [5], that the bigger the vessel the less the cost required for a ship trip. Therefore, Pelindo I plan to deepen the access channel which is accompanied by improvement of port facilities to accommodate the increased demand for services that is going to happen in the future.

This research will be doing investment decisions in improving service capacity and then test the project's feasibility based on the financial parameters that are IRR (Internal Rate of Return) and PI (Profitability Index). Comparisons between the current conditions and conditions after development projects will also be conducted to determine the value of the economic benefits of the project as seen from the parameter EIRR (Economic Internal Rate of Return) and PI. It also will test the sensitivity of the project to analyze the results of financial and economic parameters as done in the previous study in [2], [6], [7], [8] and [9].

II. METHODOLOGY

The study was conducted at the Port of Belawan and BICT that located at Suar Street No. 1, Belawan, North Sumatra. The object of research is Belawan access channel along the ± 1300 miles. Data used in the study includes data flow of ships and goods, facilities loading and unloading, as well as port services tariff. The data was obtained by means of documentary studies and interviews. Especially for the data flow of ships and goods used actual historical census data flow of ships and goods in the period 2009-2015. This historical data will be projected with statistical software Minitab 17 and Ms. Excel for a period of 30 years (project's period). Forecasting results will be used to determine the company's revenue in the future by multiplying each frequency usage related services at the prevailing rate. Besides that, forecasting results are also used to calculate the investment needs of the facility in the future. These calculations are used to determine the required number of loading and unloading facilities such as cranes, conveyors, loading point and loading-unloading labor, as well as additional quay length. After that productivity of the port after the deepening of the access channel will be obtained. The value is expressed in port productivity BOR (Berth Occupancy Ratio). Berth Occupancy Ratio is the ratio between the amounts of usage of each dock available at the time available. The formula for calculating the BOR is as follows [10]:

$$BOR = \frac{(n\ Call\ x(\bar{x}LOA+5)x\ (\bar{x}\ Berthing\ Time)}{Quay\ Length\ x\ Available\ Time\ in\ 1\ Period}\ x\ 100\% \quad \text{.....(1)}$$

BOR value suggested by the Board of the Port Authority of Indonesia was 70%. This value indicates that the activities of loading and unloading in ports still can run smoothly without any significant congestion.

Having obtained the unit amounts facilities necessary, these costs will be added to the cost of dredging and maintenance to get the annual flow of investment costs. Operating cost data obtained by simulating the actual data in 2014 are multiplied by random numbers and are assumed to increase 20% every five years. After the revenue and operating costs are known, then the investment will be measured based on investment criteria parameters to be used are [11]:

1. Internal Rate of Return(IRR) is a discount rate that results in net present value equal to 0 (zero). Therefore, if the IRR calculation result is greater than the Social Opportunity Cost of Capital (SOCC) the project is feasible. If IRR is the same as the SOCC means the return of principal and under SOCC then the project is not feasible.

$$IRR = i_1 + \frac{NPV_1}{(NPV_1 - NPV_2)}(i_2 - i_1) \quad \text{.. ..... (2)}$$

Where:

i_1 = Discount factor that results in NPV_1

i_2 = Discount factor that results in NPV_2

2. Net Present Value (NPV) is the discounted net benefits of using the Social Opportunity Cost of Capital (SOCC) as the discount factor. Investment is considered feasible if NPV> 0.

$$NPV = \sum_{i=1}^{n} \overline{B}_i - \overline{C}_i = \sum_{i=1}^{n} N\overline{B}_i \quad \text{..... .. (3)}$$

Where:

NB = Net Benefit = Benefit - Cost
B = Benefit which has been discounted
C = cost which has been discounted
i = Discount Factor
n = Year (time)

3. Profitability Index (PI) is the ratio of net cash flow to the present value of the initial investment cost (initial outlay).

$$PI = \frac{\sum_i^n \frac{P_n}{(1+i)^n}}{I_o} \text{ or } PI = \frac{PVCF}{I_o} \text{..... .... (4)}$$

Where:

P = net cash flow
I = discount factor
n = period
Io = the initial investment cost
Criteria for deciding as follows:

a. PI> 1, the proposed investment /project received
b. PI <1, then the investment proposal /project rejected

Investment criteria tests are conducted for financial and economic analysis. The financial analysis is the analysis conducted to estimate the actual costs and cash flow from the perspective of those who carry out the project and calculate the financial benefits to determine the feasibility of the project. While the economic feasibility is used to measure the costs and benefits from the perspective of the general community (neighborhood) then calculates economic profit to decide the feasibility of the project. Investment criteria used in the assessment of the feasibility of both types are the same except for the IRR and NPV on financial feasibility renamed EIRR (Economic Internal Rate of Return) and ENPV (Economic Net Present Value) on the economic viability [12].

In this research, economic analysis done by using the difference in the benefits received by the port and port services users (ship owners) with the plot development. In this case, the variable that is calculated is reduced waiting times for large vessels (above 8.5 meters draft) as a result of the deepened access channel. While

operating costs used in the calculation of operational costs of financial analysis that has been reduced by taxes.

Having obtained the investment criteria to test the sensitivity analysis with 6 (six) scenarios to see investments resistance to changing conditions.

III. RESULT AND DISCUSSION

A. *Productivity Studies*

Studies conducted on the productivity level of ships services performed by the port in the annual period. The actual data traffic ports of Belawan and BICT showed in Table 1.

Table 1. Data Traffic Belawan and BICT 2009-2015

No.	commentary	unit	Year						
			2009	2010	2011	2012	2013	2014	2015
Belawan									
A	Ship visits	call	3389	3190	2871	2751	2926	3560	3723
B	Goods traffic	'000 Tons	12.289	12.890	12.795	12.060	12.508	11.751	9.807
PORT BICT									
A.	Ship visits	call	479	472	442	493	546	484	500
B.	Export Import								
	1. Based on the Box								
	a. Import	Box	126.529	139.687	155.697	159.699	167.303	169.617	157.43
	b. Export	Box	134.068	147.263	164.455	169.879	189.847	191.355	184.331
	c. Transhipment	Box	2	1	-	-	-	-	-
	amount	Box	260.599	286.951	320.152	329.578	357.15	360.972	342.761

Based on Table 1 shows that the Port of Belawan traffic has decreased. This is caused by the global crisis which led to the decline of local and international trading activities. Based on Table 1projections was conducted using the software Minitab 17 with regression forecasting method as was done in previous studies [13]. The variables used in this forecast are the gross domestic product per capita purchasing power equilibrium of Indonesia (GDP), the number of Indonesian population, inflation, and the total commodity. Each regression models forecasting commodity are shown in Table 2.

Table 2. Regression Forecasting Model

No.	Dependent variable	Regression Model	R2
1	BBM	8521899 - 749.4 GDP	93.07%
2	Liquid bulk	-113 199 + 375 + 88000 GDP Inflation	66.15%
3	Dry bulk	-7511499 + 137 961 + 0.04504 Indonesian Population Inflation	95.63%
4	Animal	-109 607 + 4214 + 11.68 GDP Inflation	66.99%
5	*General cargo*	34142107 - 0.1299 Indonesian Population	71.19%
6	Foreign ships	2729 - 0.000128 Total (BBM + Bulk Dry +Liquid Bulk + Animal + General cargo)	76.20%
7	Local ship	3188 - 0.000098 Total (BBM + Dry Bulk + Liquid Bulk + Animal + General cargo)	72.57%
8	Import	13066 + 15:24 GDP	69.31%
9	Export	-56 381 + 24.40 GDP	87.89%
10	*Call*	356 + 0.000409 Total (Imports + Exports)	77.88%

After forecasting model is known, then used the app Ms. Excel to get the value of forecasting results over the next 30 years. This value is the result of the desired projection. The result of the growth projections of ships in 2016-2045 are shown in Table 3.

Table 3. Results Projected Traffic Belawan

Factor	unit	2015	2026	2036	2046
Belawan					
Total Demand	tonne	8,708,215	13,962,643	16,682,373	20,346,677
Ships Log	call	3,672	2.761	2.147	1,319
On average Cargo Ship	Ton / Ship	2.372	5.058	7.771	15.426
Required Quay Length	meter	3,167.96	3,167.96	3,167.96	3,167.96
BOR	%	33.98	39.72	51.54	60.90
BICT					
Total Demand	Box	342.761	652.583	898.608	1,234,469
Ships Log	call	500	623	742	861
On Average Cargo Ship	Box / boat	686	1047	1211	1434
Required Quay Length	meter	550	900	900	900
BOR	%	33.72	43.41	60.73	68.71

Table 2 shows that the productivity of the port was assessed using parameters Berth Occupancy Ratio (BOR). Seen that with the deepening of the access channel and the addition of port facilities, port productivity is still included in good categories that is below the standard of 70%. [14]

B. *Assessment of Economic Benefits of Investment Projects*

Investments benefits are calculated in research are the economic benefits of the project. The economic benefits are calculated in order to see the difference between the condition of 'project' and 'without project'. Benefits of the investment come from two aspects: the direct benefits (benefits gained by the harbor) and indirect benefits (benefits for users of port services). These benefits occur because of the reduction in vessel waiting costs due to lack of access channel heights for large vessels to be anchored to the port. This waiting time also leads to opportunity cost for shipowners and port management.

Opportunity cost for port management is calculated by the loss of income because the idle time of the piers when ships cannot enter on time. Meanwhile, the opportunity cost for shipowners is calculated by the additional cost for maintaining the ship condition while waiting for required high tide and the loss of income that could earn while waiting.

The project's cost-source in project's economic benefits derived from the financial cost has been reduced by the tax [12]. This value is the result of the conversion of financial cost has been reduced by the value of the income tax and value added tax. The result of the calculation of investment criteria shows that investment is economically viable. Results of the investment criteria of project's economic benefit shown in Table 4.

Table 4. Test Result of Investment Criteria of Project Economic Benefit

Df	IRR	PI
12%	23.04%	3.83
15%	23.04%	1.97
17%	23.04%	1.20

The result shows that the project is economically feasible based on the value of IRR and PI. This result is eligible enough if compared on the feasibility study of Port of Tg. Bulupandan and Socah which respectively only can get the

value of EIRR of 17.2% and 15.4% and PI of 1.44 and 1.25 with discount factor at 15% in [2] and feasibility study of Port in Baubau with EIRR of 24% and PI of 2.5 with discount factor 12% [8].

Benefits of the project were also tested with a sensitivity analysis to see the effect of uncertainty on the results of calculations of project benefits. Methods of sensitivity analysis in this study using the changes to the costs and benefits as has been done in research Investment Feasibility Studies Procurement of Equipment PT. Pelabuhan Indonesia IV (Persero) in Makassar [15]. The results of the sensitivity analysis of project benefits shown in Table 5.

Table 5. Sensitivity Analysis Project Benefits

No.	parameter Changes	df = 12%		
		IRR	NPV	PI
1	Costs up 20%, benefit fixed	20.74%	504,222,890	3.23
2	Costs fixed, benefits down 20%	18.83%	353,742,110	2.27
3	Costs up 20%, benefit down 20%	16.73%	261,482,376	1.68
4	Costs up 30%, benefit fixed	19.69%	458,093,023	2.94
5	Cost fixed, benefits down 30%	16.63%	232,371,853	1.49
6	Costs up 30%, benefits down 30%	13.71%	93,982,253	1.00

Sensitivity test showed that the project would remain viable when costs up reach or exceed 30% and benefits down does not reach or exceed 30%. This result can also be considered good since other research mostly only get the positive value when the changes do not exceed 20% such as [2] & [8].

C. *Study of Investment Criteria*

In calculating the investment criteria needed some information that is big data investments, operational costs, and the value of investment benefits. Investment data are shown in Table 6. This data was obtained through the calculation of investment needs in the future with the data flow forecasting and ship goods in 2017-2046. Cost per unit at cost components derived from the feasibility study development of the Port of Surabaya.[2]

Table 6. Investment Data

No.	Cost component	Unit	Total Physical	Unit Cost (USD)	Total Cost (USD)	Depreciation Value (USD)
I	**Physical investment**					
1	Dredging					
	a. Capital Dredging 2.7 mLWS	m^3	3,861,000	5	19,305,000	643.500
	b. Shoal Disposal	m3	579.150	7	4,054,050	135.135
	c. Maintenance Dredging	m3	3,983,088	1.66	6,611,926	220.398
2	Tools & Machines					
	a. Container Crane (2016)	Unit	1	6,025,000	6,025,000	108.450
	b. Mobile Crane (2016)	Unit	3	186.156	558.468	10.052
3	Pier construction of BICT	m2	350	248.572	87,000,200	1,740,004
II	**Non Physical investment**					
	a. Design & Engineering Consultants	-	-	20,000,000	20,000,000	400.000
	b. Administration & Concessions	-	-	12,355,464	12,355,464	247.109
	c. Cost of Feasibility Study	-	-	11.169	11.169	223
III	**Tax**	-	-	11% x Total Cost	17,151,341	
	amount				**173,072,618**	**2,857,539**

Data of benefits value and operating costs are shown in Table 7. Data benefits and operating costs have been modified, namely an increased rate of 20% every 5 years to benefit and increase annual operating costs by 20% every 5 years. Table 7 is the calculation of the cash flow of investment in 2017-2046.

Table 7. Investing Cash Flows (in thousand USD)

No.	Component	to-year				
		0	1	10	20	30
A	**Cash In Flow**					
	1. Total Revenue		87.498	151.160	267.141	423.348
	2. Investment	173.073				
	Total Inflows	173.073	87.498	151.160	267.141	423.348
B	**Cash Out Flow**					
	1. Investment Cost	173.073				
	2. Salary		15.168	20.203	26.938	32.459
	3. Materials		8.891	11.416	14.510	17.782
	4. Maintenance		5.527	7.561	9.108	11.275
	5. Administration		482	677	772	994
	6. Depreciation		9.833	11.504	9.833	10.128

Table 7. Investing Cash Flows (in thousand USD) (Advanced)

No.	Component	to-year				
		0	1	10	20	30
	7. General		3.217	4.401	5,199	6.756
	8. Insurance		980	1,340	1,583	2,057
	Total Flow Out Before Tax	173.073	44.098	57.103	67.943	81.451
C	**Income Before Tax**		43,400	94.057	199.197	341.897
	1. Taxes (25%)		10.850	23.514	49.799	85.474
	Total Flow Out After Tax		54.948	80.617	117.743	166.925
	Flow Out for Calculating IRR	173.073	45.115	69.113	107.910	156.797
D	**Net flow (NCF)**		32.550	70.543	149.398	256.423
E	**CASH FLOW FOR COMPUTING IRR**	(173.073)	42.383	82.047	159.231	266.551
	Discount Factor (15%)	1:00	0.87	0:25	0:06	0:02
	Present Value	(173.073)	36.855	20.281	9.729	4.026
F	**cummulative**	(173.073)	(136.218)	93.390	239.924	303.376

Valuation of investments is made by two factors: the Internal Rate of Return (IRR) and Profitability Index (PI). The results of the analysis of investment criteria shown in Table 8.

Table 8. Analysis of Investment Criteria

df	IRR	PI
10%	31.01%	4.71
12%	31.01%	3.73
15%	31.01%	2.75
20%	31.01%	1.83
25%	31.01%	1.34

Based on the calculation of investment criteria, investment declared eligible for all the criteria. This number is eligible enough if compared on the feasibility study of Port of Tg. Bulupandan and Socah which respectively only can get the value of IRR of 6.9% and 6.5% in [2] or the feasibility study of Baubau Port which the IRR value is 14.81% in [8].

D. *Study of Sensitivity Analysis*

The sensitivity analysis was performed to assess the robustness level of investment on changes in the factors that influence it. In this case the sensitivity analysis will be carried out by a factor of costs and benefits. This is done to see the extent to which level the investment will be profitable to conditions less favorable. The sensitivity analysis will be performed using 6 scenarios as shown in Table 9.

Table 9. Sensitivity Analysis

No.	Parameter Changes	df = 15%	
		IRR	PI
1	Costs up 20%, benefit fixed	28.68%	2.52
2	Costs fixed, benefits down 20%	23.99%	1.97
3	Costs up 20%, benefit down 20%	21.75%	1.74
4	Costs up 30%, benefit fixed	27.54%	2.41
5	Cost fixed, benefits down 30%	20:45%	1.58
6	Costs up 30%, benefits down 30%	17:15%	1.23

Based on Table 9 can be concluded that all the investment criteria that are in decent value by screenplay 6 with df = 15% of the cost up 30% and down 20% benefit. This suggests investment will still be profitable even if the decline in the value of the benefits and operating costs rise by 30%. This number is considered good since another study about ports in Indonesia mostly only feasible if the fluctuation of changes is below 20% [2] & [8].

IV. CONCLUSION

Based on the analysis of the discussion that has been done it can be concluded that financially, Belawan Port Flow development project feasible. This is evident from the forecast results showing an increase every year. Productivity port is also expected to run smoothly because based on calculations, future productivity conditions do not exceed the standard 70%. Results of testing the benefits of the project to see the difference in benefits between the state of the project and without the project showed decent results with EIRRs> discount factor and PI> 1 discount factor = 12%. Financial analysis also gives good value with IRR> discount factor and PI> 1 discount factor = 15%. The sensitivity test is done under extreme conditions with an increase in cost of 30% when the benefits down 30% and the results also showed a decent index. The results of this calculation indicate that the investment is feasible.

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