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Investment in Procurement of Mobile Cranes at Kijing Port to Increase Non-Container Production Using Financial Evaluation Method

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Abstract: This research is motivated by the significant increase in throughput at Kijing Port Branch, with an average increase of 171% from 2022 to 2024. This growth reflects the increasing demand for loading and unloading services, requiring companies to provide superior service and meet the growing market demand. However, on-the-ground conditions indicate that loading and unloading equipment, particularly key equipment such as mobile cranes, remains very limited. This limitation results in low cargo volumes being served. Therefore, to increase service capacity and maximize market potential, additional loading and unloading equipment and a restructuring of the service system at Kijing Port dock are required. In this regard, a comprehensive investment feasibility study is necessary, both from a financial and operational perspective. This research used secondary data, including production throughput data, and primary data from informants or sources. Using the variables of Investment Value, Rate of Return, Investment Period, Operating Income, and Operating Costs, a feasibility calculation is obtained, including Net Present Value (NPV), Benefit Cost Ratio (B/C Ratio), Profitability Index (PI), Payback Period (PP), and Internal Rate of Return (IRR). These calculations are then tested using sensitivity analysis and potential risks, and the potential increase in non-container cargo handling is calculated. The analysis provides a strong quantitative basis for determining investment strategies based on the NPV, IRR, BCR, PI, and PP. These indicators assist in assessing risk, weighing lease and purchase alternatives, and ensuring that mobile crane investment decisions truly add value to the company.

Keywords: Non-Container Cargo, Mobile Crane, Financial Evaluation, Investment, Port.

INTRODUCTION

The growth of domestic and international trade is increasingly driving the importance of this port. Data from the West Kalimantan Central Statistics Agency shows that the province's Gross Regional Domestic Product increased by an average of 6.71% per year from 2019 to 2025. Meanwhile, the maritime trade sector experienced growth of up to 11% per year between 2021 and 2024. With this development, the non-container throughput target at Kijing Port is

projected to reach 6 million tons by 2030. Based on 2023 data, the loading and unloading equipment capacity at Kijing Port only reached 1.4 million tons per year, while the volume of non-container cargo had reached 2.4 million tons. This cargo growth is very significant, with an average increase of 171% from 2022 to 2024. This imbalance between equipment capacity and cargo volume has caused various problems, such as suboptimal cargo absorption, increasing ship queues, and high rental costs for Mobile Crane equipment from partners. Therefore, PT Pelabuhan Indonesia (Persero) Kijing Branch needs to plan superstructure investment in the form of independent procurement of loading and unloading equipment as a strategic step to overcome these limitations.

This study was conducted to analyze the feasibility of investing in stevedoring equipment procurement at Kijing Port and compare it with equipment rental schemes from partners, in the context of a rapidly developing new strategic port. This approach is important because, as Gittinger (1986) points out, thorough investment assessment is essential to support efficient decision-making in public infrastructure management. This study is also considered limited in the scientific literature and industry reports, and therefore could make an important contribution.

The novelty of this study lies in its context and object of study, namely its focus on non-container superstructure investment at Kijing Port, which has not been widely discussed. Furthermore, the approach used not only evaluates the financial feasibility of the investment but also compares direct investment options with equipment rental alternatives, as suggested by Brealey, Myers, and Allen (2014) that project evaluations should consider all financing alternatives to achieve optimal results. The results of this study are expected to serve as a practical reference for port managers, investors, and policymakers in formulating effective, efficient, and revenue-driven investment strategies for loading and unloading equipment, driven by the continued growth of non-container cargo in Indonesia.

Based on the above background, this study aims to: (1) Evaluate the feasibility of procuring loading and unloading equipment at Kijing Port to support operational activities compared to leasing. (2) Test the sensitivity of loading and unloading equipment investment to changes in investment parameters, taking into account investment risk.

METHOD

This study adopted a quantitative approach with the primary objective of assessing the investment feasibility of procuring a mobile crane at Kijing Port. The evaluation was conducted using financial indicators such as Net Present Value (NPV), Internal Rate of Return (IRR), Benefit Cost Ratio (BCR), Profitability Index (PI), and Payback Period (PP), in accordance with the principles outlined by Brigham and Houston (2010) and Ross, Westerfield, and Jordan (2012), which emphasize the importance of numerical analysis in investment decision-making. Primary data was obtained through semi-structured interviews with the General Manager of the Port Branch and the Director of Operations and Engineering to obtain information regarding investment value, non-container throughput projections, equipment usage rates, and operational costs. Meanwhile, secondary data was collected from internal company documents and official sources, such as stevedoring production reports, revenue data, costs, and benchmark interest rates.

Data validation was conducted rigorously through information triangulation between sources, cross-checking with official documents, logical consistency tests between variables, and member checking, as necessary. All data was processed using a Microsoft Excel spreadsheet to generate investment feasibility indicators and equipment capacity simulations. A sensitivity analysis was also conducted to assess the investment's resilience to changes in key parameters such as human resource costs, material prices, service rates, and loading and

unloading volumes, each with a ±5% inflation scenario. This approach aims to provide a realistic picture of potential investment risks.

Furthermore, the equipment's operational capacity was calculated to determine the annual volume of non-containerized cargo the mobile crane can handle. This is crucial for estimating the equipment's contribution to improving loading and unloading efficiency and reducing vessel waiting times. By combining quantitative methods and comprehensive data validation, this study provides a strategic basis for management in formulating data-driven investment decisions that reflect real-world port conditions.

RESULT AND DISCUSSION

Identifying Cargo Potential at Kijing Port

Kijing Port is located in West Kalimantan Province, a region with a geographically extensive hinterland, covering 147,037 km², or approximately 1.13 times the size of Java Island. This location makes Kijing Port highly strategic, supported by abundant natural resources, both in the mining and plantation sectors. West Kalimantan is known for its high mining potential, particularly bauxite, coal, iron sand, gold, tin, and aluminum, as well as plantation products such as oil palm, which is processed into crude palm oil (CPO).

Bauxite production in the province has shown significant growth, from 5.6 million metric tons (MT) in 2018 to 11.6 million MT in 2020. Bauxite is the primary raw material for alumina, whose production has increased with the presence of an alumina processing plant in West Kalimantan. This plant, the result of a USD 941 million investment by PT ANTAM Tbk and Inalum, will begin operations in September 2024 with a production capacity of 1 million tons of alumina per year and requires approximately 3.3 million tons of bauxite as raw material.

In addition to the mining sector, West Kalimantan also has a strong palm oil industry. PT Energi Unggul Perkasa produces approximately 1.5 million tons of CPO per year, while PT Wilmar Group produces 2 million tons annually, not including contributions from other major companies such as PT Apical and PT Astra Agro Lestari. Fertilizer production in the region is also growing with the establishment of PT Saraswanti Anugrah Indonesia's Fertilizer Plant in 2023, capable of producing approximately 700,000 tons of fertilizer per year.

With its significant resource and industrial production potential, Kijing Port plays a vital role in supporting logistics and export activities, serving as a strategic hub for the distribution of West Kalimantan's leading commodities to both domestic and international markets.

Production data shows consistent year-on-year growth. In 2021, production was recorded at 3,450, increasing to 4,120 in 2022, and then rising again to 4,580 in 2023. In 2024, realized production was 4,730, and for the projection period, it is estimated to reach 4,950 in 2025, then 5,210 in 2026, 5,490 in 2027, and finally 5,770 in 2028. These figures reflect a steady growth trend in both actual and projected volumes.

This situation indicates that non-container loading and unloading at Kijing Port is experiencing positive development in line with economic growth, the potential of the hinterland in West Kalimantan Province, and the development of various industrial sectors in the region. This growth projection assumes a fixed tariff and an average inflation rate of 2% per year.

When viewed from the types of cargo that mobile cranes can handle, namely general cargo, bag cargo, and dry bulk, the data also shows consistent growth. In 2021, production was recorded at 1,250, then increased to 1,430 in 2022, rising again to 1,620 in 2023, and reaching 1,780 in 2024. For future projections, production is estimated to reach 1,950 in 2025, increasing to 2,120 in 2026, rising again to 2,300 in 2027, and reaching 2,480 in 2028. This confirms that cargo production requiring mobile cranes will continue to grow consistently.

However, with only two units currently operating, each with a production capacity of approximately 1.4 million tons per year, there is a significant gap. From 2026 to 2028, an estimated gap of 600,000 to 1.2 million tons of unmanaged cargo is expected. Given this

situation, the minimum requirement is an increase of three mobile crane units. Moreover, cargo growth is projected to reach 13% per year by 2025, while Kijing Port still faces limitations in its superstructure, particularly the availability of loading and unloading equipment.

From 2021 to 2024, the port relied solely on leased equipment from partners for loading and unloading, resulting in high costs. If we look at other production data, in 2021 it was recorded at 2,140, increasing to 2,360 in 2022, rising again to 2,540 in 2023, and reaching 2,710 in 2024. Projections show the trend continuing with an achievement of 2,890 in 2025, increasing to 3,070 in 2026, increasing to 3,260 in 2027, and reaching 3,460 in 2028. Assuming a mobile crane rental cost of IDR 25,000 per ton, the expenses incurred can be estimated to exceed IDR 40 billion per year, so that investment in additional equipment is an urgent need to make the port more efficient and competitive.

Investment Cost and Funding Analysis

In the Kijing Port development project, the costs associated with the planned investment in mobile crane procurement have been identified. Based on production data, a consistent upward trend is observed from 2021 to 2024. In 2021, production was recorded at 1,520, rising to 1,690 in 2022, then increasing again to 1,850 in 2023, and reaching 2,010 in 2024. This positive trend is projected to continue, with production estimated at 2,180 in 2025, 2,350 in 2026, 2,530 in 2027, and reaching 2,720 in 2028.

In terms of investment costs, or Capital Expense (CAPEX), the main components include the procurement of a 180-ton mobile crane, a grab crane attachment, and delivery costs (mob-de-mob). The procurement price for the mobile crane was set at USD 911,854 at an exchange rate of IDR 16,450 per dollar. Using the straight-line depreciation method over five years, the annual depreciation expense is IDR 1,000,000,000. This expense is a critical component in calculating operational costs, as it reflects the decline in the economic value of assets used in the loading and unloading process.

Meanwhile, operational expenses (OPEX) consist of several main components, both fixed and variable costs. Employee costs are a fixed cost, totaling IDR 1,168,000,000 per year, calculated based on the West Kalimantan Provincial Minimum Wage (UMP) plus allowances for equipment operators and maintenance personnel. Material costs are a variable cost, reaching IDR 17,781,120,000, dominated by industrial fuel at IDR 21,000 per liter. With a machine capacity of 150 tons per hour and a total annual working time of 14,112 hours, fuel consumption is recorded at 846,720 liters, resulting in significant annual costs.

Furthermore, water and electricity costs are also variable, totaling Rp1,449,000,000 per year, as well as routine and unforeseen maintenance costs of Rp3,330,744,000. This maintenance includes preventive maintenance based on the machine's hour meter and corrective maintenance, estimated at around 3% of the investment value, equivalent to Rp1.4 billion per year. Lubricant use is a significant component of preventive maintenance, with requirements varying depending on the type of lubricant. For engine, axle, motor, and grease lubricants, the estimated total cost is Rp1,881,744,000 per year.

Other costs include insurance, a fixed cost of Rp1,449,000,000, calculated from an annual premium of 3% of the investment value, and variable general and administrative costs of Rp966,000,000 and Rp483,000,000 per year, respectively. Given this complex cost structure, it can be concluded that the investment requirement for mobile cranes at Kijing Port extends beyond equipment procurement, but also to the high operational costs that must be anticipated to ensure efficient loading and unloading operations.

Funding for the investment in mobile crane loading and unloading equipment is planned to come from a combination of equity and borrowed capital. Equity capital accounts for 30% of the total funding requirement, amounting to Rp14,490,000,000, allocated to support initial

capital expenditures (CAPEX) and operational costs (OPEX). The remaining 70%, or Rp33,810,000,000, will be obtained through bank loans.

The company utilized loan capital to cover significant funding needs, particularly related to asset acquisition and operational financing. The loan was subject to interest from the Investment Limited Liability Company (Bank Persero Investasi), with the highest interest rate in 2024, at 9.47% for investment loans. For comparison, the 12-month deposit interest rate for the same period was recorded at 5.92%. These two interest rates were used as the basis for calculating the WACC (Weighted Average Cost of Capital), which was then used in the financial feasibility analysis, including the calculation of Net Present Value (NPV), Internal Rate of Return (IRR), Profitability Index (PI), and sensitivity analysis to assess the risks and potential returns on investment.

Cash Flow Analysis Using the Discounted Cash Flow Method

The investment cost for this project is IDR 48,300,000,000. The financing model is Equity and Debt, with 30% equity and 70% debt, and the source of financing is bank debt. This model is used because all port transactions are related to banking and to determine whether financing through loans or 100% equity is more attractive.

After determining the investment value and net operating income from loading and unloading operations, the cash flow analysis uses the discounted cash flow method. The discounted cash flow method assumes that future cash flows are not equivalent to current cash flows. This method is suitable for analyzing the expected cash inflows of a mobile crane rental business, as if the cash flows were received currently, taking into account interest expenses.

WACC (Weighted Average Cost of Capital)

WACC is the interest rate used as a baseline in evaluating and comparing various alternatives. WACC is the minimum value of an expected rate of return or interest rate that an investor can receive from an investment. The WACC can be calculated as follows:

$$WACC = \left(\frac{E}{V} x\ Re\right) + \left(\frac{D}{V} x\ Rd\ x\ (1 - T)\right)$$

$$WACC = \left(\frac{14.490.000.000}{48.300.000.000} x\ 5{,}92\%\right) + \left(\frac{33.810.000.000}{48.300.000.000} x 9{,}47\%\ x\ (1 - 22\%)\right)$$

$$WACC = 6{,}95\%$$

Where :

E = Equity
D = Debt
V = Total Modal
Re = Cost of Equity
Rd = Cost of Debt
T = Tax

Analysis of Equipment Capacity, Cost of Goods Sold, and Revenue

To determine the revenue from the mobile crane procurement investment project, calculations were performed based on the equipment's operating capacity and the rental rates offered. Three mobile cranes were used in the operation, with an average of one per vessel. The average cycle time was six minutes, with a load capacity of 15 tons per cycle, resulting in a working capacity of 150 tons per hour. With an effective working day of 21 hours per day, production per unit reached 3,150 tons per day. Calculated over a 320-day workweek and a 70% utilization rate, production per unit reached 705,600 tons per year. With three mobile cranes, total annual production could reach 2,116,800 tons.

Based on the operational cost analysis, total expenditure reached IDR 38,039,792,243, covering various components. Fixed costs include employee salaries of Rp1,168,000,000, maintenance costs of Rp3,330,744,000, insurance of Rp1,449,000,000, depreciation of Rp9,660,000,000, and interest costs of Rp1,752,928,243. Meanwhile, variable costs consist of fuel of Rp17,781,120,000, electricity and water of Rp1,449,000,000, general costs of Rp966,000,000, and administration of Rp483,000,000. If the total costs are divided by the annual capacity of 2.1 million tons, the cost of goods manufactured (COGS) is Rp17,970 per ton. By adding a profit margin of 35%, the set rental rate is Rp24,260 per ton. This rate is Rp740 per ton lower than the cost of renting equipment through partners, thus increasing service competitiveness.

Table 1. Potential Revenue with Owned Equipment

No	Year	General Cargo	Bag Cargo	Dry Bulk	Total Cargo	Rental Rates	Potential Income
1	2021	60.308	116.984	18.592	195.884	Rp.24.260	Rp.4.752.155.010
2	2022	127.871	152.139	55.803	335.813	Rp.24.260	Rp.8.146.847.419
3	2023	313.497	170.862	200.067	684.426	Rp.24.260	Rp.16.604.223.753
4	2024	512.615	242.281	1.022.451	1.777.347	Rp.24.260	Rp.43.118.559.949
5	2025	579.255	273.778	1.155.369	2.008.402	Rp.24.260	Rp.48.723.972.742
6	2026	631.388	298.418	1.259.353	2.189.158	Rp.24.260	Rp.53.109.130.289
7	2027	688.213	325.275	1.372.694	2.386.182	Rp.24.260	Rp.57.888.952.015
8	2028	750.152	354.550	1.496.237	2.600.939	Rp.24.260	Rp.63.098.957.696
9	2029	766.152	371.550	1.516.237	2.653.939	Rp.24.260	Rp.64.384.741.490

Source: PT. Pelabuhan Indonesia (Processed Data, 2025)

From the calculation above, it can be seen that by owning our own equipment, we can generate revenue without rental costs, with the potential for average annual revenue exceeding Rp50 billion.

Financial Analysis

The financial aspect is used to calculate the ratio between project expenses and revenues, and to determine whether the project can secure the necessary funding and its ability to repay the investment. This financial aspect involves calculating bank loan repayment scenarios, feasibility calculations based on NPV, IRR, BCR, PI & PP, and sensitivity to changes in loading and unloading volume, tariffs, human resource costs, and material costs using the Base, Best & Worst approaches, each with a 5% inflation rate.

Loan Repayment Analysis

This mobile crane procurement investment project is funded by equity and bank loans, as explained below:

Table 2. Loan Repayment Scenario Calculation

Investment Value	**48.300.000.000**	*rupiah (million)*
Equity (Own Capital)	**30%**	
or	**14.490.000.000**	*rupiah*
Down Payment (DP)	**0**	*rupiah*
Loan Value	**33.810.000.000**	*rupiah)***
Installment / Tenor	**5.00**	*years (**max 20**)*
or	**60**	*months*
Interest Rate	**9.47%**	*per year*
Monthly Installment	**709.577.354**	*per month)**

Annual Installment	**8.514.928.213**	*per year*
Extra Installments	0	*months*
interest period	12	*months*
total per period	0	*rupiah*
gross income	**780.335.189**	*rupiah (+110%)**
Total Interest	**8.704.641.213**	*rupiah*
payment ratio	**20.59%**	*of principal*
Total Principal	33.810.000.000	*rupiah)***
total loan	**42.514.641.213**	*rupiah*
fully paid	**60**	*months*
or	**5.0**	*Years*

Source: Author's Editing, 2025

Based on an investment value of IDR 48.3 billion, with 30% equity (IDR 14.49 billion), and 70% debt (IDR 33.81 billion), with an investment interest rate of 9.47%, the cumulative interest expense is IDR 8.7 billion, resulting in a total interest and loan expense of IDR 42.57 billion, which will be repaid over five years, as follows:

Table 3. Loan Installment Calculation

Year	Outstanding Principal (Rp)	Principal Installment (Rp)	Interest Installment (Rp)	Remaining Balance (Rp)
2025	33.810.000.000	5.549.908.297	2.965.019.945	28.260.091.703
2026	28.260.091.703	6.098.907.694	2.416.020.549	22.161.184.009
2027	22.161.184.009	6.702.214.355	1.812.713.888	15.458.969.654
2028	15.458.969.654	7.365.200.539	1.149.727.864	8.093.769.215
2029	8.093.769.215	8.093.769.215	421.158.967	0

Source: Author's Editing, 2025

The table above explains that the loan term runs from 2025 to 2029 for five years, with a principal loan amount of IDR 33.81 billion, repaid annually at IDR 8.5 billion, consisting of principal and interest.

Feasibility Calculation for Scenario 1 (Base Calculation)

Table 4. Feasibility Calculation for Base Calculation

Uraian		2024	2025	2026	2027	2028	2029
Investasi		**48.300.000.000**					
Pinjaman		**33.810.000.000**					
Penyesuaian Throughput			0,0%				
Tarif Sewa Alat Mobile Crane			24.260	24.260	24.260	24.260	24.260
Perubahan Tarif			0,0%				
Kenaikan Biaya SDM			0%				
Kenaikan Biaya Bahan			0%				
Throughput BM Curah Kering			2.008.402	2.189.158	2.386.182	2.600.939	2.653.939
Pendapatan Stevedoring			48.723.972.742	53.109.130.289	57.888.952.015	63.098.957.696	64.384.741.490
Total Pendapatan			48.723.972.742	53.109.130.289	57.888.952.015	63.098.957.696	64.384.741.490
Biaya Pegawai			1.168.000.000	1.168.000.000	1.168.000.000	1.168.000.000	1.168.000.000
Biaya Bahan Bakar			17.781.120.000	17.781.120.000	17.781.120.000	17.781.120.000	17.781.120.000
Biaya Listrik & Air			1.449.000.000	1.449.000.000	1.449.000.000	1.449.000.000	1.449.000.000
Biaya Perawatan			3.330.744.000	3.330.744.000	3.330.744.000	3.330.744.000	3.330.744.000
Biaya Asuransi			1.449.000.000	1.449.000.000	1.449.000.000	1.449.000.000	1.449.000.000
Biaya Umum			966.000.000	966.000.000	966.000.000	966.000.000	966.000.000
Biaya Administrasi			483.000.000	483.000.000	483.000.000	483.000.000	483.000.000
Biaya Pokok Pinjaman			5.549.908.297	6.098.907.694	6.702.214.355	7.365.200.379	8.093.769.275
Bunga			2.965.019.945	2.416.020.549	1.812.713.888	1.149.727.864	421.158.967
Depresiasi			9.660.000.000	9.660.000.000	9.660.000.000	9.660.000.000	9.660.000.000
Total Biaya			44.801.792.243	44.801.792.243	44.801.792.243	44.801.792.243	44.801.792.243
EBIT			6.887.200.445	10.723.358.595	14.899.873.660	19.446.893.318	20.004.108.215
EBT			3.922.180.500	8.307.338.047	13.087.159.773	18.297.165.454	19.582.949.248
Tax	22%		862.879.710	1.827.614.370	2.879.175.150	4.025.376.400	4.308.248.835
EAT			**3.059.300.790**	**6.479.723.676**	**10.207.984.623**	**14.271.789.054**	**15.274.700.413**

Investasi							
Net Cash Flow		-14.490.000.000	12.719.300.790	16.139.723.676	19.867.984.623	23.931.789.054	24.934.700.413
Akumulasi Net Cash Flow		-14.490.000.000	-1.770.699.210	14.369.024.466	34.237.009.089	58.168.798.143	83.103.498.556
		0	1	2	3	4	5
DF		100,0%	93,5%	87,4%	81,8%	76,4%	71,5%
Discounted Cashflow		-14.490.000.000	11.893.130.227	14.111.135.695	16.242.490.629	18.293.925.762	17.822.508.782
Akumulasi Discounted Cashflow		-14.490.000.000	-2.596.869.773	11.514.265.922	27.756.756.550	46.050.682.312	63.873.191.094
NPV	**63.873.191.094**						
WACC	**6,95%**						
IRR	**104,35%**						
Benefit Cost Ratio	**0,22**						
Profitability Index	**1,62**						
Payback Period	**2**	**Tahun**					

Source: Author's Editing, 2025

Based on the calculation for scenario 1 (base calculation), the NPV for the mobile crane procurement investment is IDR 1,000,000. 63,873,191,094, an IRR of 104.35%, a BCR of 0.22, a PI of 1.62, and a payback period of 2 years indicate that the mobile crane investment is feasible, considering the NPV above 0, the IRR above the WACC, the PI above 1, and the payback period of 2 years, although the BCR does not approach 1.

Feasibility Calculation for Scenario 2 (Best & Worst) Changes in Human Resource Costs

Table 5. Feasibility Sensitivity Calculation for Changes in Human Resource Costs

NO	Sensitivitas	Uraian	Base	Best	Worst
1	Biaya SDM	NPV	63.873.191.094	64.060.230.538	63.686.151.651
2		IRR	104,35%	104,64%	104,06%
3		BCR	0,22	0,22	0,22
4		PI	1,62	1,63	1,62
5		PP	2	2	2

Source: Author's Editing, 2025

Based on the feasibility calculation for scenario 2 above, the NPV is 64,060,230,538, the IRR is 104.64%, the BCR is 0.22, the PI is 1.63, and the payback period is 2 years. This indicates that the mobile crane investment is feasible under this best approach, as the NPV is above 0. IRR is above WACC, PI is above 1 and PP for 2 years even though BCR is below 1 while for the worst approach the NPV value is 63,686,151,651, IRR is 104.06%, BCR is 0.22, PI is 1.62 and PP for 2 years which shows that even using the worst conditions the feasibility of mobile crane investment can still be said to be feasible because NPV is above 0, IRR is above WACC, PI is above 1, PP for 2 years even though BCR is below 1.

Feasibility Calculation for Scenario 3 (Best & Worst) Changes in Material Costs

Table 6. Feasibility Sensitivity Calculation for Changes in Material Costs

NO	Sensitivitas	Uraian	Base	Best	Worst
1	Biaya Bahan	NPV	63.873.191.094	66.720.597.598	61.025.784.590
2		IRR	104,35%	108,76%	99,94%
3		BCR	0,22	0,24	0,20
4		PI	1,62	1,68	1,56
5		PP	2	2	2

Source: Author's Editing

Based on the feasibility calculation for scenario 3 above, it can be explained that using the best approach, the NPV is 66,720,597,598, the IRR is 108.76%, the BCR is 0.24, the PI is 1.68, and the PP is 2 years. This indicates that under this best approach, the mobile crane investment is considered feasible because the NPV is above 0, the IRR is above the WACC, the PI is above 1, and the PP is 2 years even though the BCR is below 1. Meanwhile, for the worst approach,

the NPV is 61,025,784,590, the IRR is 99.94%, the BCR is 0.20, the PI is 1.56, and the PP is 2 years. This indicates that even using the worst case scenario, the mobile crane investment is still considered feasible because the NPV is above 0, the IRR is above the WACC, and the PI is above 1. PP for 2 years even though the BCR is below 1.

Feasibility Calculation for Scenario 4 (Best & Worst) Tariff Changes

Table 7. Feasibility Sensitivity Calculation for Tariff Changes

NO	Sensitivitas	Uraian	Base	Best	Worst
1	Tarif	NPV	63.873.191.094	72.982.524.221	54.763.857.968
2		IRR	104,35%	117,31%	91,32%
3		BCR	0,22	0,27	0,17
4		PI	1,62	1,81	1,43
5		PP	2	1	2

Source: Author's Editing, 2025

Based on the feasibility calculation for scenario 4 above, it can be explained that with the best approach, the NPV is 72,982,524,221, the IRR is 117.31%, the BCR is 0.27, the PI is 1.81, and the PP is 1 year. This indicates that, under this best approach, mobile crane investment is considered feasible because the NPV is above 0, the IRR is above the WACC, the PI is above 1, and the PP is 2 years even though the BCR is below 1. Meanwhile, with the worst approach, the NPV is 54,763,857,968, the IRR is 91.32%, the BCR is 0.17, the PI is 1.43, and the PP is 2 years. This indicates that, even under the worst conditions, mobile crane investment is feasible. It can still be considered feasible because the NPV is above 0, the IRR is above the WACC, the PI is above 1, and the PP is valid for 2 years even though the BCR is below 1.

Feasibility Calculation for Scenario 5 (Best & Worst) Volume Change

Table 8. Feasibility Sensitivity Calculation for Volume Change

NO	Sensitivitas	Uraian	Base	Best	Worst
1	Throughput	NPV	63.873.191.094	72.982.524.221	54.763.857.968
2		IRR	104,35%	117,31%	91,32%
3		BCR	0,22	0,27	0,17
4		PI	1,62	1,81	1,43
5		PP	2	1	2

Source: Author's Editing, 2025

Based on the feasibility calculation for scenario 5 above, it can be explained that with the best approach, the NPV is 72,982,524,221, the IRR is 117.31%, the BCR is 0.27, the PI is 1.81, and the PP is valid for 1 year. This indicates that, under this best approach, the mobile crane investment can be considered feasible because the NPV is above 0, the IRR is above the WACC, the PI is above 1, and the PP is valid for 2 years even though the BCR is below 1. Meanwhile, for the worst approach, the NPV is 54,763,857,968, the IRR is 91.32%, the BCR is 0.17, and the PI is 1.43 and a PP for 2 years, indicating that even under the worst-case scenario, the feasibility of investing in a mobile crane is still considered feasible, as the NPV is above 0, the IRR is above the WACC, the PI is above 1, and the PP for 2 years, even though the BCR is below 1.

Feasibility Calculation for Scenario 6 (Best & Worst) for All Conditions

Table. 9. Feasibility Sensitivity Calculation for All Conditions

NO	Sensitivitas	Uraian	Base	Best	Worst
1	Semua Kondisi	NPV	63.873.191.094	85.581.769.952	43.075.545.549
2		IRR	104,35%	135,60%	74,15%
3		BCR	0,22	0,35	0,10
4		PI	1,62	2,07	1,19
5		PP	2	1	2

Source: Author's Editing, 2025

Based on the feasibility calculation for scenario 6 above, it can be explained that using the best approach, the NPV is 85,581,769,952, the IRR is 135.60%, the BCR is 0.35, the PI is 2.07, and the PP is 1 year. This indicates that, under this best approach, the mobile crane investment is considered feasible because the NPV is above 0, the IRR is above the WACC, the PI is above 1, and the PP is 2 years even though the BCR is below 1. Meanwhile, using the worst approach, the NPV is 43,075,545,549, the IRR is 74.15%, the BCR is 0.10, the PI is 1.19, and the PP is 2 years. This indicates that even using the worst conditions, the mobile crane investment is still considered feasible because the NPV is above 0, the IRR is above the WACC, the PI is above 1, and the PP is 2 years even though the BCR is below 1.

Based on all sensitivity results, it is clear that the investment is feasible. However, the sensitivity analysis revealed that the feasibility is significantly affected by fluctuations in fuel costs and declining throughput volumes. This indicates that risk management needs to focus on operational efficiency and cargo diversification strategies. Compared to the leasing option, the investment offers a higher profit margin after the sixth year, despite requiring a substantial initial outlay.

Comparison between Sensitivities

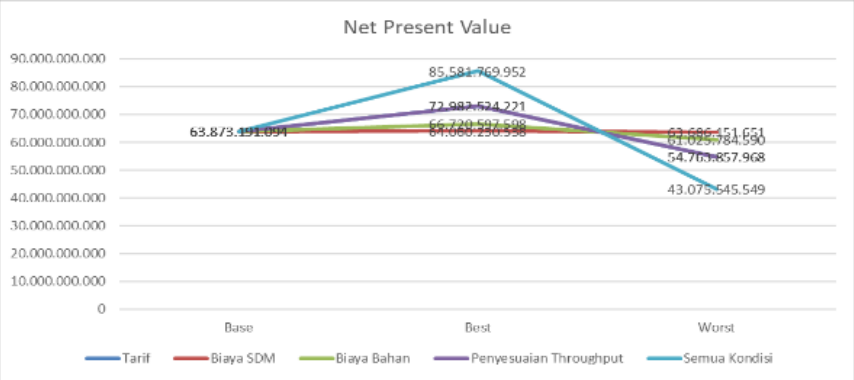

Figure 1. NPV Comparison Graph for Various Sensitivities and Scenarios

Source: Author's Editing, 2025

Based on the graph above, the NPV values obtained for various sensitivities and scenarios are highest, namely under the best conditions, with all sensitivities accommodated, with an NPV of 85,581,769,952, and the lowest value of 43,075,545,549. This indicates that the investment is still feasible even under conditions where all sensitivities are accommodated and under the worst-case scenario.

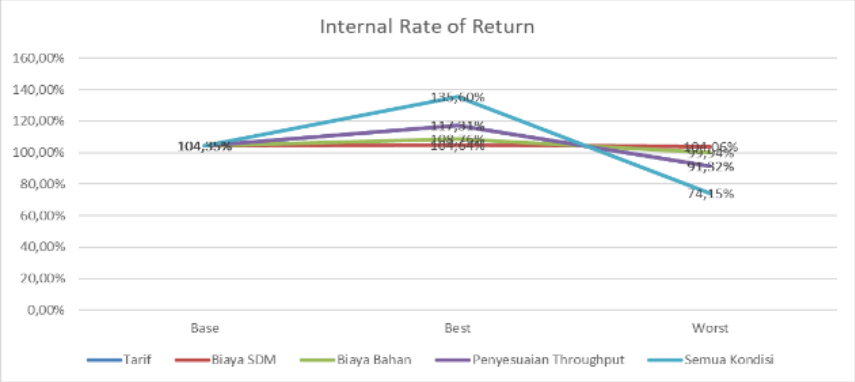

Figure 2. Comparison Chart of IRRs for Various Sensitivities and Scenarios
Source: Author's Editing, 2025

The graph above, based on IRR values from various sensitivities and scenarios, shows the highest value of 135.6% in the best-case scenario and the lowest value of 74.15% in the worst-case scenario. All sensitivity conditions are accommodated, and under these conditions, the investment is still feasible because the IRR remains above the WACC value, regardless of the conditions.

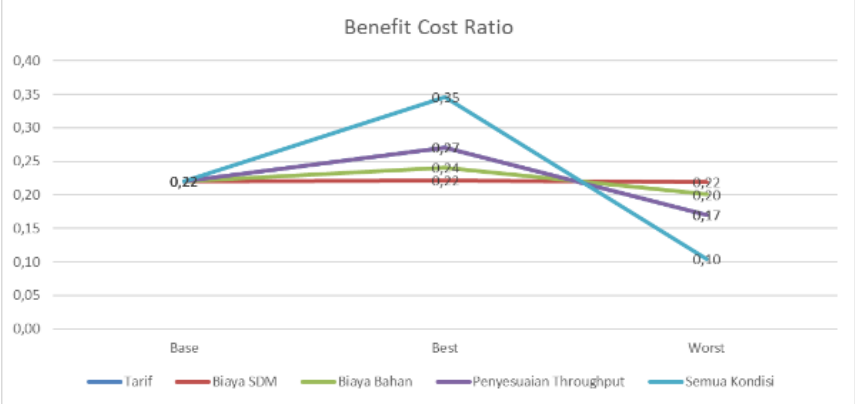

Figure 3. Comparison Chart of BCRs for Various Sensitivities and Scenarios
Source: Author's Editing, 2025

Based on the graph above, the comparison of BCR values shows that the highest value is 0.35 in the best-case scenario and the lowest value is 0.1 in the worst-case scenario. Although the BCR is still below 1 for all sensitivities, feasibility is still considered feasible because the BCR is not the sole determinant of investment feasibility. Even if the BCR is below 1, the risks are not significant because the project still generates sufficient profits and is able to cover depreciation costs.

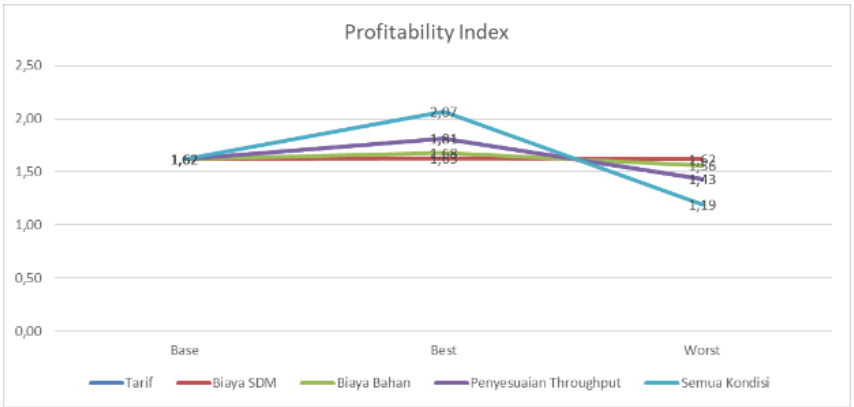

Figure 4. Comparison Graph of PI Values for Various Sensitivities and Scenarios
Source: Author's Edit, 2025

Meanwhile, based on the graph above, comparing PI values for various sensitivities and scenarios, the highest value is 2.07 in the best case scenario and the lowest value is 1.19 in the worst case scenario. This indicates that, despite the various sensitivities, the PI value remains above 1, indicating that the project has a beneficial value even in the worst-case scenario.

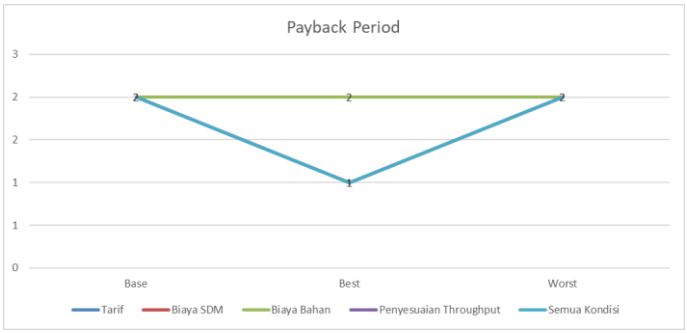

Figure 5. Comparison Graph of PP Values for Various Sensitivities and Scenarios
Source: Author's Edit, 2025

Based on the graph above, comparing PP values for various sensitivities and scenarios, this investment project has the longest payback period, between 1 and 2 years, indicating that this investment project has a short and feasible timeframe.

By comparing the sensitivity above, the benefits of a port project are not only calculated in terms of direct financial gains, but also in terms of externalities such as improved connectivity, cargo absorption, reduced ship waiting times, and increased national logistics competitiveness. Therefore, the BCR indicator sometimes does not reflect the overall economic value. Even if the BCR is <1, other indicators such as a positive NPV, IRR > WACC, PI >1, and a short PP already indicate that the project remains financially profitable.

Comparative Analysis of Renting vs. Own Procurement

Table 10. Comparison of Rental Costs and Own Procurement Costs

No	Year	Total Cargo	Rental Cost (Rp/Ton)	Self-Procurement Cost (Rp/Ton)	Total Rental Cost	Total Self-Procurement Cost	Cost Efficient
1	2021	195.884	Rp 25.000	Rp 17.970	Rp 4.897.095.000	Rp 3.520.114.822	Rp 1.376.980.178
2	2022	335.813	Rp 25.000	Rp 17.970	Rp 8.395.325.000	Rp 6.034.701.792	Rp 2.360.623.208
3	2023	684.426	Rp 25.000	Rp 17.970	Rp 17.110.650.000	Rp 12.299.425.003	Rp 4.811.224.997
4	2024	1.777.347	Rp 25.000	Rp 17.970	Rp 44.433.669.333	Rp 31.939.674.036	Rp 12.493.995.297
5	2025	2.008.402	Rp 25.000	Rp 17.970	Rp 50.210.046.346	Rp 36.091.831.661	Rp 14.118.214.685
6	2026	2.189.158	Rp 25.000	Rp 17.970	Rp 54.728.950.517	Rp 39.340.096.510	Rp 15.388.854.007
7	2027	2.386.182	Rp 25.000	Rp 17.970	Rp 59.654.556.064	Rp 42.880.705.196	Rp 16.773.850.868
8	2028	2.600.939	Rp 25.000	Rp 17.970	Rp 65.023.466.110	Rp 46.739.968.664	Rp 18.283.497.446
9	2029	2.653.939	Rp 25.000	Rp 17.970	Rp 66.348.466.110	Rp 47.692.401.104	Rp 18.656.065.006

Source: Author's Editing, 2025

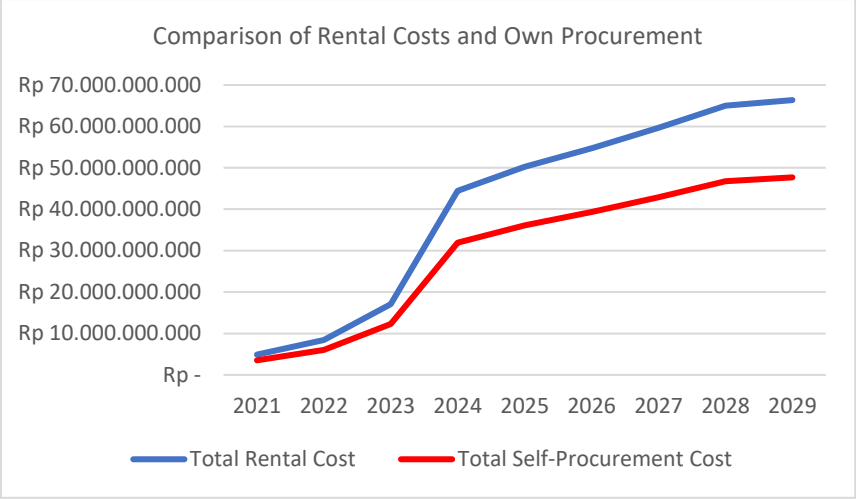

Figure 6. Graph of Comparison of Rental Costs and Own Procurement
Source: Author's Editing, 2025

From the table and graph above, it can be seen that renting a mobile crane at a rate of IDR 25,000/ton will result in annual costs of IDR 50-66 billion from 2025 to 2029. Procuring the equipment yourself will result in operational and investment costs of IDR 17,970/ton (based on calculations in Table 4.13), resulting in a total annual cost of IDR 36-47 billion from 2025 to 2029. This results in cost savings of IDR 1.5 billion. 14-18 billion per year from 2025 to 2029, plus the added benefit of owning mobile cranes compared to renting equipment from partners. Therefore, the procurement of mobile cranes is considered feasible, and compared to leasing equipment from partners, it is significantly more cost-effective. By procuring these assets, the Port has its own assets, enabling it to establish policies regarding equipment tariffs and supporting the Port's vision of reducing logistics costs. Furthermore, control over equipment and operational activities can be carried out independently without relying on external parties (equipment vendors).

By procuring its own assets, the Port can establish policies related to equipment tariffs and support the Port's vision of reducing logistics costs. Furthermore, it can manage equipment and operational activities independently, without relying on external parties (equipment vendors).

Operational Analysis of Mobile Crane Procurement

The procurement of three mobile cranes significantly impacts operational aspects, particularly the equipment placement and operational service patterns that Kijing Port can provide.

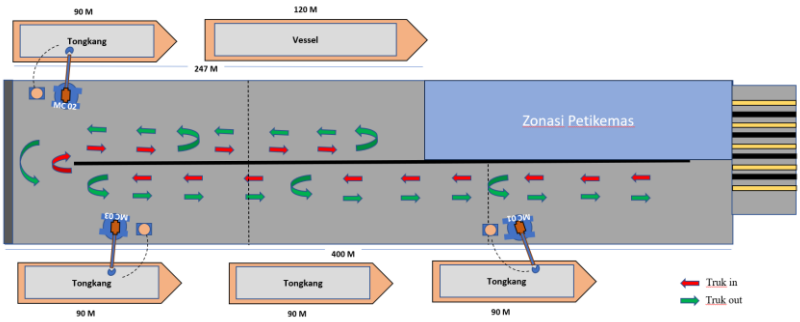

Figure 7. Layout plan for the placement of three mobile cranes (Author's Edit, 2025)

With the addition of three mobile cranes, the equipment placement is divided into two main areas: one unit on the north side serving two berths and two units on the south side serving

three berths. This configuration aims to improve loading and unloading performance, from two partner-owned cranes to three independently owned cranes with greater capacity.

Capacity calculations are based on a work cycle with an average time of six minutes per hook and a load of 15 tons per cycle. This results in a working capacity of 150 tons per hour. With an effective working day of 21 hours per day, each crane can produce 3,150 tons per day. There are 320 effective working days per year, after accounting for 36 days for maintenance, with a 70% equipment utilization rate. Based on these parameters, annual production per crane reaches 705,600 tons, resulting in a total annual production of 2,116,800 tons.

This capacity is expected to meet the increasing throughput needs at Kijing Port, particularly by accelerating loading and unloading service performance. Furthermore, by procuring new equipment, the company not only reduces dependence on partners but also enhances its logistics competitiveness. This enables services for non-container cargo that previously could not be handled optimally, thus making a positive contribution to port efficiency and productivity in the future.

CONCLUSION

The results of this study indicate that mobile crane investment at Kijing Port has strategic potential in increasing the capacity of non-container loading and unloading services. From a managerial perspective, investment decisions should be prioritized over rental schemes because they can reduce dependence on third parties, reduce long-term operational costs, and improve service reliability. Furthermore, the sensitivity analysis results emphasize the importance of risk management for variable costs of human resources, fuel, and fluctuations in cargo volume. Therefore, port management is required to implement adaptive financial planning, strict operational cost controls, and marketing strategies that can attract more non-container throughput. This study contributes to the relatively limited literature on financial evaluation of port superstructure investments in Indonesia. The integration of capital budgeting methods (NPV, IRR, BCR, PI, PP) with sensitivity analysis in the context of mobile crane investment presents an applicable approach that can be used as a reference for further research. Furthermore, the comparison between investment and rental options enriches empirical studies on equipment procurement strategies in the port sector. Thus, this research not only strengthens the theoretical basis of maritime technology and economic management, but also opens up space for the development of cross-port comparative studies and analysis of transportation infrastructure investment policies in the future.

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