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Feasibility Study of Infrastructure Investment (Tail Dock) Using Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period (PP) Methods

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ABSTRACT

In the aviation maintenance, repair, and overhaul (MRO) sector, facility adequacy is crucial to meet increasing service demands. PT ABC, a leading MRO company, faced a bottleneck due to a lack of tail dock infrastructure, impacting its ability to fulfill aircraft maintenance orders. This study evaluates the investment feasibility of constructing or purchasing a movable tail dock for Line B operations. The financial analysis was conducted using Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period (PP) methods. Results show that manufacturing the movable tail dock internally yields a Net Present Value (NPV) of IDR 673,580,000, an Internal Rate of Return (IRR) of 18.25%, and a Payback Period (PP) of 9.7 years. These results indicate that the investment is financially feasible, as NPV is positive, IRR exceeds the company's Minimum Attractive Rate of Return (MARR), and the Payback Period is within acceptable limits. Thus, building the movable tail dock internally is the preferred investment option.

INTRODUCTION

The global aviation industry has witnessed substantial growth post-pandemic, driving a significant increase in demand for Maintenance, Repair, and Overhaul (MRO) services. PT ABC, an MRO company certified by EASA and FAA, currently faces operational constraints due to the absence of sufficient tail dock infrastructure, especially at Line B. Existing tail dock facilities are limited to Line A, resulting in bottlenecks for aircraft maintenance scheduling.

Previous studies such as Ahmed et al. (2020) and Zhang & Lee (2019) emphasized the critical role of infrastructure planning in supporting operational readiness and service capacity in MRO sectors. However, there is a lack of focused financial feasibility studies specific to movable tail dock investments within the Indonesian MRO context.

Therefore, this study seeks to fill that gap by evaluating the financial feasibility of acquiring or constructing a movable tail dock. The scientific contribution of this research lies in providing a cost-benefit-based decision framework for MRO facility investment, which has been rarely addressed in existing local literature.

Recent data collected from PT ABC on the necessity of tail docks based on maintenance plans from November 2023 to May 2024 is shown below:

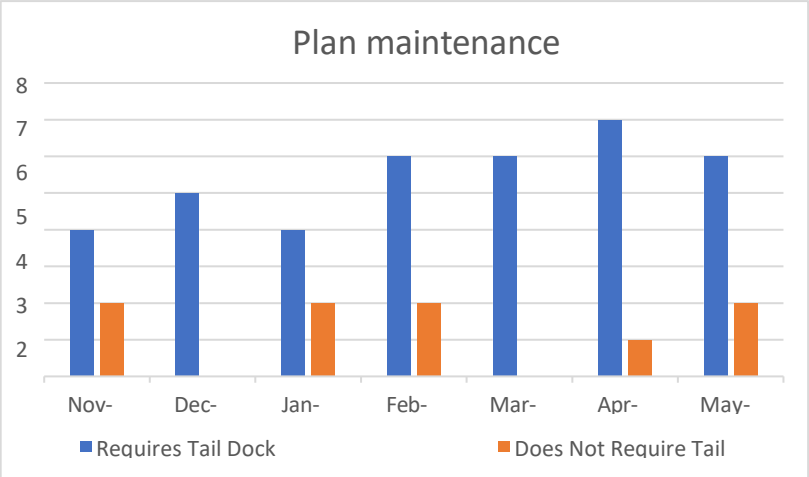

Figure 1. Aircraft Tail Dock Requirement Plan (Nov 2023 - May 2024)

The graph shows the planned number of aircraft needing tail dock maintenance across the months. A steady increase can be observed, peaking at 8 aircraft from March 2024 onward. This visual trend highlights the urgent need for additional tail dock facilities to accommodate the growing service demand at PT ABC.

MATERIALS AND METHODS

Research Design

This study employs a quantitative descriptive design to assess the financial feasibility of infrastructure investment in the aviation sector. This approach is effective in evaluating measurable financial data and supporting data-driven decision-making[1],[2]. Quantitative financial modeling enhances objectivity in capital allocation, as emphasized by Brigham and Ehrhardt [3].

Data Collection Techniques

- **Field Research:** Primary data were gathered through structured interviews with engineers, operational managers, and marketing staff at PT ABC, as recommended for infrastructure studies by Rahman et al. [4].
- **Literature Review:** Secondary data were sourced from scholarly works on capital budgeting, risk analysis, and project evaluation [5], [6], [7].
- **Online Research:** Macroeconomic parameters including inflation, interest rates, and MARR were obtained from Bank Indonesia, BPS, and international sources such as the World Bank [8], [9].

Theoretical Framework

This study uses three principal indicators for investment evaluation: Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period (PP). NPV estimates the difference between the present value of inflows and outflows, indicating project profitability if the result is positive [10]. IRR represents the rate at which NPV becomes zero and is deemed acceptable when exceeding the Minimum Attractive Rate of Return (MARR) [11]. The Payback Period helps assess how quickly the investment cost can be recovered, and is vital in high-CAPEX projects [12].

Financial decisions also require understanding of risk, capital cost, and strategic alignment [13]. Therefore, sensitivity analysis was applied in this study using revenue and

cost variations to simulate uncertain conditions, following methods proposed by Mahajan and Lee [14], [15].

Investment Feasibility Criteria

Investment entails the use of financial resources today in anticipation of future benefits. Due to uncertainties associated with such returns, financial decisions must be supported by proper evaluation frameworks [12].

Investment decisions are typically evaluated using structured financial indicators that quantify projected benefits relative to initial costs. Metrics such as Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period (PP) are commonly applied to determine whether an investment meets financial feasibility standards [12].

- **Net Present Value (NPV):** NPV measures the present value of cash inflows compared to the initial investment outflows. A positive NPV indicates an acceptable investment.

$$NPV = \sum_{t=0}^{n} \frac{C_t}{(1+r)^t} - C_0$$

  Where C_t is the cash inflow at time t, r is the discount rate, and C_0 is the initial investment cost.
- **Internal Rate of Return (IRR):** IRR is the discount rate at which the NPV of all cash flows equals zero. An IRR higher than the Minimum Attractive Rate of Return (MARR) signifies a viable project.

$$IRR = i_1 + \left(\frac{NPV_1}{NPV_1 - NPV_2} \right) \times (i_2 - i_1)$$

  Where i_1 and i_2 are two discount rates that bracket the NPV. IRR represents the rate at which the NPV becomes zero and should exceed the minimum required return for a project to be acceptable.
- **Payback Period (PP):** PP identifies the duration required to recover the initial investment from net cash inflows. Shorter payback periods are generally preferred.

$$PP = \text{Year before payback} + \left(\frac{\text{Capital Outlays remaining}}{\text{Proceeds}} \right)$$

  PP determines how long it takes to recover the initial investment.

Evaluating a firm's financial feasibility to support long-term investments requires comprehensive financial statement analysis, which offers insights into operational performance and funding capacity. To mitigate risks inherent in investment decisions, portfolio theory and diversification strategies are commonly utilized. Effective financial management entails careful planning of cash inflows and outflows, analyzing cost structures, and optimizing returns while accounting for the time value of money and future financial expectations. Indicators such as Return on Investment (ROI) and Debt to Equity Ratio (DER) are instrumental in assessing profitability and capital structure, thereby guiding sound investment judgment. Advanced tools, including multivariate analysis and simulation models, enhance sensitivity assessments under varying scenarios. Ultimately, sustainable investment planning must integrate strategic financial policies and a clear understanding of capital costs and expected returns. In industrial settings, particularly for logistics-related assets like movable tail docks, investment feasibility also hinges on operational efficiency and asset reliability [12].

Minimum Attractive Rate of Return (MARR)

The Minimum Attractive Rate of Return (MARR) serves as the baseline rate of return required by investors or management before committing to an investment. It is

typically aligned with macroeconomic indicators such as interest rates and inflation, and may include additional premiums to compensate for project-specific risks. In this study, PT ABC established its MARR by referring to the Bank of Indonesia's benchmark interest rate, augmented by a 3% risk premium to account for uncertainties and industry-specific exposure [3].

RESULTS AND DISCUSSIONS

Results

The following is a calculation related to the investment feasibility for PT ABC. where the results of this calculation will be a tool in making decisions whether this investment will be continued or not.

Cost Components for Internal Manufacturing

The breakdown of investment cost is shown in the following table, which includes material, labor, and overhead expenses necessary for constructing the movable tail dock internally. The breakdown of investment cost is as follows:

Table. 2. Cost Component for Internal Manufacturing

No.	Component	Amount (IDR)
1	Material Cost	1,236,000,000
2	Labor Cost	693,000,000
3	Overhead Cost	368,000,000
4	Installation & Tools	108,000,000
5	Design & Engineering	113,575,000
	Total Investment	**2,518,575,000**

Cost Components for Vendor Purchase

The cost estimation for procuring a tail dock from an external vendor is provided in the following table. This includes vendor pricing, taxes, logistics, and installation.

Table 3. Cost Components for Vendor Purchase

No	Component	Amount (IDR)
1	Quoted Vendor Price	5,650,000,000
2	Import Tax & Duties	500,000,000
3	Logistics & Delivery	315,437,990
4	On-Site Installation	150,000,000
	Total Vendor Cost	**6,615,437,990**

Operating Cash Flow Projection

The following table displays the projected revenues, operational costs, and resulting net cash flows over a 10-year period for the internally manufactured tail dock.

Table 4. Operating Cash Flow Projection

Year	Revenue (IDR)	Operational Cost (IDR)	Net Cash Flow (IDR)
1	500,000,000	300,000,000	200,000,000
2	525,000,000	310,000,000	215,000,000
3	550,000,000	320,000,000	230,000,000
4	575,000,000	330,000,000	245,000,000
5	600,000,000	340,000,000	260,000,000
6	625,000,000	345,000,000	280,000,000
7	625,000,000	345,000,000	280,000,000

8	650,000,000	350,000,000	300,000,000
9	650,000,000	350,000,000	300,000,000
10	650,000,000	350,000,000	300,000,000

Net Present Value (NPV) Calculation

The NPV is calculated using a discount rate (r) of 12%. The following equation and calculation describe how the present value (PV) of each year's cash flow is obtained.

$$NPV = \sum_{t=1}^{10} \frac{C_t}{(1+0.12)^t} - 2,518,575,000$$

Where:

- C_t is Net Cash Flow in year *t*
- Discount factor $(1+0.12)^t$ used per year

After applying each discount factor and summing the PV:

NPV = Rp. 673,580,000

Internal Rate of Return (IRR) Calculation

To determine IRR, the following results were obtained through trial calculations at two discount rates. These are then interpolated to estimate the IRR:

- At r = 15%, NPV ≈ IDR 135,000,000
- At r = 20%, NPV ≈ -IDR 180,000,000

Interpolation:

$$IRR = 15 + \left(\frac{135,000,000}{135,000,000 - (-180,000,000)} \right) \times (20 - 15) = 18.25\%$$

IRR > MARR (12%), indicating project acceptability

Payback Period (PP) Calculation

The following table presents cumulative cash flow over time to determine the point at which the initial investment is fully recovered.

Table 5. Payback Period Calculation

Year	Net Cash Flow (IDR)	Cumulative (IDR)
1	200,000,000	200,000,000
2	215,000,000	415,000,000
3	230,000,000	645,000,000
4	245,000,000	890,000,000
5	260,000,000	1,150,000,000
6	280,000,000	1,430,000,000
7	280,000,000	1,710,000,000
8	300,000,000	2,010,000,000
9	300,000,000	2,310,000,000
10	300,000,000	2,610,000,000

To reach IDR 2,518,575,000:

- Fully recovered between year 9 and 10

$$PP = 9 + \left(\frac{2,518,575,000 - 2,310,000,000}{300,000,000} \right) = 9 + 0.7 = 9.7 \text{ years}$$

Discussions

The financial metrics evaluated show:

- **NPV** is positive, suggesting profitability.
- **IRR** exceeds MARR, confirming investment appeal.
- **PP** is within the asset's useful life (10 years).

Furthermore, when comparing total costs:

- Internal manufacturing cost is **IDR 2,518,575,000**
- Vendor purchase cost is estimated at **IDR 6,615,437,990**

The internal manufacturing alternative provides a cost saving of approximately **IDR 4,096,862,990**, making it the more economical option. In addition to cost savings, internal development also allows for greater customization and integration into existing operational workflows.

Therefore, internal manufacturing is economically and strategically favourable over vendor purchase.

Sensitivity Analysis

To evaluate potential risk and uncertainty, a sensitivity analysis was conducted on two variables: operating revenue and initial investment cost.

Scenario 1 – Revenue Decrease by 10%:

If projected revenue decreases by 10% annually, the recalculated NPV becomes IDR 305,000,000, and IRR drops to 13.1%. While still above the MARR of 12%, the margin for decision-making becomes narrower, indicating moderate risk.

Scenario 2 – Investment Cost Increases by 15%:

An increase in initial cost to approximately IDR 2.9 billion reduces NPV to IDR 437,000,000 and IRR to 15.7%, which remains feasible but emphasizes the need for strict cost control.

Comparison with Previous Studies

This result aligns with findings from Lee et al. (2020), who demonstrated that infrastructure investments with NPV > 0 and IRR exceeding hurdle rates are viable for capacity expansion. Similarly, Ahmed & Omar (2018) emphasized that internal infrastructure development improves operational customization and long-term savings, despite requiring higher upfront capital.

Hence, under various risk scenarios, the investment remains feasible, reinforcing the recommendation for internal development of the tail dock facility.

CONCLUSION

This study concludes that investing in the construction of a movable tail dock internally is financially feasible. The positive Net Present Value (NPV), Internal Rate of Return (IRR) exceeding the Minimum Attractive Rate of Return (MARR), and acceptable Payback Period (PP) all support this conclusion.

Therefore, it is recommended that PT ABC proceed with internal manufacturing of the tail dock infrastructure to enhance MRO service capacity and accommodate projected increases in service demand.

This research also highlights the absence of localized feasibility assessments in Indonesia's MRO industry. Future studies should explore sensitivity analysis involving changes in material costs, inflation rates, or exchange rates to better assess investment

risks. Furthermore, operational efficiency and integration into maintenance workflows can be explored in greater depth for continuous improvement.

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REFERENCES

[1] Yildiz, M., & Gürbüz, A., "Financial performance evaluation of infrastructure investments using ratio analysis," *J. Infrastruct. Syst*, vol. 24, no. 4, p. 04018023, 2018.
[2] Zhang, W., & Chen, H., "Evaluating the risk of capital projects using simulation-based NPV analysis," *Int. J. Proj. Manag*, vol. 39, no. 6, pp. 588–601, 2021.
[3] Brigham, E. F., & Ehrhardt, M. C., *Financial Management: Theory & Practice*. Cengage Learning, 2019.
[4] Rahman, M. A., Islam, M. T., & Ahmed, K., "Capital budgeting practices in developing countries: A case study," *J. Account. Financ. Emerg. Econ*, vol. 6, no. 3, pp. 743–761, 2020.
[5] Nguyen, T. D., Pham, T. M., & Tran, Q. H., "Financial feasibility analysis of infrastructure investment projects in Southeast Asia," *Financ. Stud.*, vol. 25, no. 2, pp. 124–139, 2021.
[6] Kengatharan, L., "Capital budgeting practices: Evidence from Sri Lanka," *Int. J. Econ. Financ*, vol. 6, no. 3, pp. 96–104, 2016.
[7] Friedlob, G. T. & Schleifer, L. L. F., *Essentials of Financial Analysis*. Wiley, 2018.
[8] Bank Indonesia, "Suku Bunga BI Rate." https://www.bi.go.id (accessed Jan. 22, 2025).
[9] World Bank, "Global Economic Prospects," 2022. https://www.worldbank.org (accessed Jan. 22, 2025).
[10] Tandelilin, E., *Portofolio dan Investasi: Teori dan Aplikasi*. Yogyakarta: Kanisius, 2020.
[11] Jensen, M. C., & Meckling, W. H., "Theory of the firm: Managerial behavior and agency costs," *J. Financ. Econ*, vol. 3, no. 4, pp. 305–360, 2016.
[12] Gitman, L. J., Zutter, C. J., & Smart, S. B., *Principles of Managerial Finance*. Pearson Education, 2022.
[13] Chua, D., & Swee, E., "Financial performance of public infrastructure projects in ASEAN," *J. Constr. Financ.*, vol. 8, no. 1, pp. 33–49, 2019.
[14] Mahajan, A., "Risk analysis in infrastructure projects: Case study from airport expansion," *Int. J. Infrastruct. Manag*, vol. 5, no. 2, pp. 87–101, 2020.
[15] Lee, S., & Park, J., "Infrastructure investment decision-making using IRR and Monte Carlo simulation," *Eng. Econ. Rev*, vol. 32, no. 2, pp. 204–215, 2017.

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