www.ijecs.in
International Journal Of Engineering And Computer Science
Volume 14 Issue 09 September 2025, Page No. 27702-27708
ISSN: 2319-7242 DOI: 10.18535/ijecs/v14i09.5242

Feasibility Evaluation of Truck Purchase Investment Using the Net Present Value, Payback Period, and Internal Rate of Return Approach a Case Study at PT XYZ

Riki Ridwan Margana[1], Yani Iriani[2] Verani Hartati[3], Okky Kusumah Dewi[4]

[1,2,3,4]Department of Industrial Engineering, Universitas Widyatama, Bandung, Indonesia.

Abstract

Ensuring cost-effective logistics operations is a critical factor in sustaining competitiveness within Indonesia's manufacturing and distribution industries. The textile chemical distribution sector is particularly challenged by escalating rental charges for third-party trucks, which have risen by approximately 15% annually, thereby creating long-term financial pressure and reducing control over operations. To address this concern, the company evaluated the feasibility of acquiring its own truck as an alternative.

This study applies a descriptive-quantitative approach to compare leasing with truck ownership, employing Net Present Value (NPV), Payback Period (PP), Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) as evaluation indicators. Distribution demand from 2020 to 2027 was projected using seasonal decomposition, achieving a MAPE of 12.4%, which indicates reliable accuracy for cash flow forecasting. Although both options resulted in negative NPVs, truck ownership demonstrated more favorable outcomes. The investment's payback period of 4.5 years remains within the truck's eight-year economic life. Furthermore, the IRR of 16.21% surpasses the firm's Minimum Attractive Rate of Return (MARR) of 15%, with a MIRR of 15.9% confirming feasibility. Overall, truck acquisition is more advantageous than leasing, offering financial efficiency, improved operational control, and strengthened supply chain resilience.

Keywords — Investment feasibility, Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period (PP), seasonal decomposition, logistics.

1. Introduction

The logistics sector is central to industrial competitiveness in Indonesia, a country with vast geographic coverage and a large domestic market. High logistics costs—nearly a quarter of the national GDP—remain a major barrier compared to regional peers such as Thailand and Malaysia. These conditions create financial strain for manufacturing and distribution firms, with transportation costs representing the largest share of total logistics expenditures.

The textile chemical distribution sector is one of the industries most affected by such conditions. This sector heavily depends on land transportation, especially trucking, for moving products between warehouses and customers. Many companies rely on third-party truck rental services to reduce the need for upfront capital. However, rental fees have been rising at an average rate of 15% per year, driven by inflation, fuel price volatility, and increased demand for logistics [2], [6]. Over time, this upward trend creates a significant financial burden and reduces managerial control over distribution activities.

In response to these challenges, companies have begun considering truck ownership as an alternative to third-party rentals. Purchasing a truck provides greater control over delivery schedules, ensures reliability, and may reduce long-term costs. Nevertheless, it requires substantial capital expenditure and continuous operating costs, including fuel, tolls, driver salaries, maintenance, and taxes [11]. This trade-off between high initial investment and potential cost savings makes the decision complex, necessitating careful evaluation using systematic financial analysis.

Engineering economics provides well-established tools for investment evaluation. Widely applied indicators include Net Present Value (NPV), Payback Period (PP), and Internal Rate of Return (IRR) [3], [12], [19]. NPV assesses profitability by discounting future cash flows [18]. PP evaluates liquidity and risk by measuring the recovery time for initial capital [15], [20]. IRR identifies the discount rate at which NPV equals zero, used as a benchmark against the company's Minimum Attractive Rate of Return (MARR). Together, these indicators form a comprehensive basis for project appraisal.

In addition, demand forecasting plays an essential role in investment appraisal, as it influences projected revenues and cost utilization. This study applies the **seasonal decomposition method** to forecast distribution demand from 2020 to 2027. The method is suitable for capturing recurring seasonal patterns in demand, thereby providing a more accurate basis for cash flow projections [13], [14]. Combining financial feasibility analysis with demand forecasting ensures that the evaluation reflects both cost structures and market realities.

Previous studies reinforce the relevance of this approach. Barnes and Langworthy [2] highlighted the rising costs of vehicle operation with age, underscoring the importance of long-term cost control in transportation. Ibrahim and Rinienta [11] analyzed transportation investments in Indonesia, emphasizing fuel, maintenance, and depreciation as key financial considerations. Ndubizu [15] demonstrated that discounted payback is more appropriate for long-term projects, while Weber [19] emphasized NPV as the most reliable measure of investment worth. These studies provide a theoretical foundation for applying investment appraisal methods in the logistics sector.

Against this background, the central research question addressed in this study is:

Is truck purchase more financially feasible than leasing third-party trucks in a textile chemical distribution company in Indonesia?

To answer this question, the study pursues the following objectives:

1. To forecast the company's distribution demand for 2020–2027 using seasonal decomposition.
2. To estimate operational costs for both alternatives: leasing and purchasing.
3. To calculate investment indicators (NPV, PP, IRR, and MIRR) for each option.
4. To evaluate the financial and strategic implications of truck ownership versus leasing.

The main contribution of this study is to provide empirical evidence for investment decision-making in the logistics sector, particularly among medium-sized companies in Indonesia. While much of the literature on investment appraisal focuses on manufacturing or infrastructure projects, relatively few studies address transportation investment decisions in niche industries such as textile chemical distribution. By filling this gap, the study aims to support managerial decision-making and contribute to the broader field of engineering economics and logistics management.

The structure of this paper is as follows: Section 2 outlines prior studies on investment feasibility and transportation, Section 3 describes the research methodology encompassing forecasting and financial analysis, Section 4 presents the findings on demand forecasts, cost comparison, and investment indicators, and Section 5 provides the conclusion.

2. Literature Review

Investment decisions in logistics and transportation are capital-intensive and long-term in nature, requiring thorough assessment. Engineering economics offers frameworks to guide such analysis, with NPV, PP, and IRR frequently used in both academic and practical contexts [3], [12], [19].

NPV is often regarded as the most comprehensive criterion since it incorporates the time value of money by discounting projected cash flows [18], [19]. PP, by contrast, emphasizes liquidity by measuring how quickly an investment recovers its initial costs, though it ignores returns beyond the recovery horizon [15], [20]. IRR identifies the discount rate where NPV equals zero, providing a benchmark relative to the company's MARR [12]. MIRR has been proposed as a refinement, accounting for reinvestment assumptions [4].

Transportation investment studies emphasize the importance of cost components such as fuel, maintenance, depreciation, and tolls. Barnes and Langworthy [2] showed that operating costs increase significantly with vehicle age, influencing total ownership cost calculations. In the Indonesian context, Ibrahim and Rinienta [11] highlighted that maintenance and fuel expenditures are critical in determining the feasibility of purchasing commercial vehicles. Furthermore, Ndubizu [15] emphasized that discounted payback analysis

provides a more accurate picture for long-term transportation projects, while Weber [19] reinforced the reliability of NPV as a decision criterion.

Forecasting demand is another critical aspect of logistics investment appraisal. Distribution volume directly influences cost efficiency and vehicle utilization. Time-series methods such as **seasonal decomposition** are particularly useful for industries with cyclical demand patterns [13], [14]. Accurate forecasting reduces the risk of underutilization or capacity shortages, providing a realistic foundation for making sound investment decisions. Studies such as those by Lestari et al. [13] confirm that forecasting accuracy, measured by indicators like Mean Absolute Percentage Error (MAPE), is vital for reliable investment analysis.

In addition to financial and forecasting perspectives, strategic considerations also play a role. Engholm et al. [5] argued that ownership of logistics assets enhances supply chain resilience by reducing dependency on third parties. Similarly, Gan et al. [6] highlighted that companies with dedicated fleets gain better control over service quality and delivery reliability. These findings underscore that transportation investments should not be evaluated solely on financial metrics but also on their broader impact on competitiveness and operational performance.

In summary, the literature suggests that integrating financial feasibility indicators with demand forecasting provides a robust framework for evaluating transportation investments. By adopting this dual approach, companies can balance quantitative financial outcomes with qualitative strategic benefits, leading to more informed and sustainable decisions.

3. Methods

3.1 Research Design

This research adopts a quantitative methodology that is both descriptive and analytical in nature. The quantitative approach is selected because investment feasibility analysis emphasizes numerical calculations, while the descriptive-analytical method is used to describe the company's current conditions and analyze two decision alternatives:

1. **Alternative A**: continue using third-party truck rental services.
2. **Alternative B**: purchase a new truck for distribution.

The objective of this research design is to **compare the two alternatives** using financial indicators, including **NPV**, **PP**, and **IRR**.

3.2 Research Data

Primary data were collected via interviews with company managers and observation of operations. Secondary data included historical rental costs, truck prices, operational costs (fuel, tolls, maintenance, taxes, driver wages), and distribution volumes. Additional assumptions were derived from published literature [2], [11], [13].

Secondary data were also collected from relevant literature to support calculation assumptions, such as **Barnes and Langworthy [2]** for vehicle cost per mile, and **Lestari et al. [13]** for seasonal forecasting.

3.3 Forecasting Distribution Needs

The initial step is **forecasting distribution needs** for the next five years. The **seasonal decomposition method** is applied because distribution data exhibit recurring seasonal patterns each year [13].

General formula of seasonal decomposition:

$$Y_t = T_t + S_t + C_t + E_t$$

Where:

- Y_t = actual data at period t
- T_t = trend component
- S_t = seasonal factor
- C_t = cyclical factor
- E_t = error/residual

Seasonal decomposition was applied to forecast demand for 2020–2027, capturing recurring annual fluctuations [13]. Forecasting accuracy was validated using Mean Squared Error (MSE), Mean Absolute Deviation (MAD), and Mean Absolute Percentage Error (MAPE) [14].

3.4 Cost and Cash Flow Estimation

After demand projection, the next step is to **calculate costs** for each alternative:

- **Alternative A (Truck Rental)**:
  Costs are calculated as rental rates per shipment multiplied by the number of trips per year, assuming a 15% annual increase.
- **Alternative B (Truck Purchase)**:
  Costs include the initial investment for vehicle purchase, annual operational costs (fuel, tolls, driver salaries, maintenance, taxes), and the vehicle's residual value at the end of its economic life.
  Depreciation is calculated using the straight-line method according to standard accounting practices [11]:

3.5 Financial Anal

Financial analysis is

$$\text{Depreciation} = \frac{\text{Initial Cost} - \text{Residual Value}}{\text{Economic Life}}$$

ent feasibility indicators:

1. **Net Present**

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

   Criterion: project is feasible if $NPV > 0$ [19].

2. **Payback Period**
   PP = Time required to recover initial investment

For time value of money, **Discounted Payback Period (DPP)** is used [15].

3. **Internal Rate of Return**
   Interpolation formula for IRR:

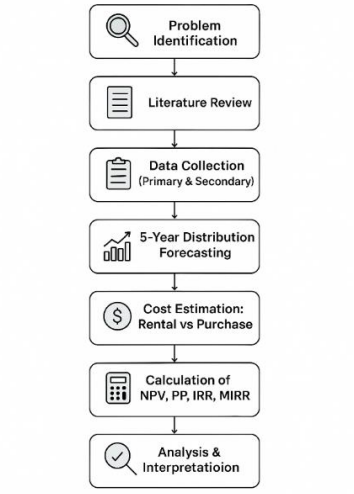
$$IRR = r_1 + \frac{NPV_1}{NPV_1 - NPV_2}(r_2 - r_1)$$

Criterion: project is feasible if $IRR \geq MARR(15\%)$.

In addition, the Modified Internal Rate of Return (MIRR) is applied to account for reinvestment assumptions [4].

3.6 Research Framework

The research flow is illustrated in **Figure 1**:
Flowchart of Research Methodology:



This framework ensures that the research is conducted systematically to produce **valid and accountable results**.

4. Results and Discussion

4.1 Distribution Needs Forecasting Results

The first step was to project distribution needs for the 2020–2027 period using the seasonal decomposition method. Based on historical shipment data from 2015–2019, the distribution pattern shows a declining trend due to fluctuations in textile industry demand and the impact of the global pandemic.

The model calculation yielded a MAPE value of 12.4%. This level of accuracy is considered acceptable, aligning with the benchmarks established in forecasting literature [14]. Therefore, the forecast results are suitable for use as a basis for preparing investment cash flow.

Table 1. Distribution Demand Projection (2020–2027)

Year	Demand (Shipments)	Remarks
2020	580	Start of analysis period
2021	562	Demand decrease
2022	550	Stable
2023	545	Stable
2024	538	Beginning to slowly increase
2025	542	Demand recovery
2026	548	Upward trend
2027	555	End-of-period projection

The table shows that although a decrease occurred at the beginning of the period, demand tended to stabilize and began to recover after 2024.

(This projection chart can later be presented as **Figure 1. Distribution Demand Projection Chart 2020–2027**).

4.2 Alternative Cost Analysis

a. Alternative A – Truck Rental

Rental costs were calculated based on the rate per trip, assuming a 15% annual increase. Calculations show that total rental costs increased significantly year-on-year, reflecting a long-term financial burden for the company.

b. Alternative B – Truck Purchase

The initial investment for purchasing a new truck is IDR 950 million. Operational costs include:

- **Fuel:** IDR 160 million/year
- **Tolls:** IDR 85 million/year
- **Driver's salary:** IDR 60 million/year
- **Maintenance & taxes:** IDR 45 million/year

  Depreciation is calculated using the straight-line method over an 8-year economic life with a residual value of IDR 150 million [11].

Table 2. Annual Cost Summary – Rental vs. Purchase

Component	Rental (IDR)	Purchase (IDR)
Initial investment	–	950,000,000
Operational costs	820,000,000	350,000,000
Annual increase	15%	5–8%
Final residual value	–	150,000,000

A comparison of the table shows that although purchasing requires a large initial investment, the annual operational costs are lower compared to the rental scheme.

4.3 Financial Analysis

a. Net Present Value

Applying an 8% discount rate yielded the following outcomes:

- **NPV Rental:** IDR 1,464,905,648

- **NPV Purchase:** IDR 1,188,596,987
  Although both are negative, the NPV value for purchase is better than rental. This indicates that purchasing is more efficient in the long run [19].

b. Payback Period

- The purchase investment is recouped in **4.5 years**.
- Vehicle economic life = **8 years**.
- Accordingly, the payback occurs before the completion of the economic lifespan, which reflects the principle of efficient investment [20].

c. Internal Rate of Return

The interpolated IRR was 16.21%, exceeding the 15% MARR, indicating that the truck investment is financially viable [12].

d. Modified IRR.

The MIRR calculation showed a result of **15.9%**, which is more realistic compared to the conventional IRR. This supports the conclusion that the truck purchase project is feasible [4].

4.4 Discussion of Results

The analysis results show that purchasing a truck is more rational compared to renting. Several important points for discussion are:

1. **Long-Term Cost Efficiency**
   Rental costs increased sharply due to rate inflation, while the operational costs of purchasing were more controllable. This finding aligns with research by Barnes and Langworthy [2] and Gan et al. [6], which emphasize the importance of cost per mile control.
2. **Liquidity and Risk**
   The 4.5-year payback period shows that the investment risk is manageable. Ndubizu [15] also affirms that discounted payback provides a more realistic picture for long-term transportation projects.
3. **Return on Investment**
   The 16.21% IRR, which is greater than the established MARR, indicates that the project generates a return exceeding the firm's minimum requirement [12], [19].
4. **Strategic Implications**
   With fleet ownership, the company gains full control over distribution, improves timeliness, and reduces dependence on third parties. This supports supply chain resilience, as emphasized in the study by Engholm et al. [5].
5. **Non-Financial Factors**
   In addition to financial aspects, the purchase decision also provides additional benefits in the form of improved company image and operational flexibility. However, external risks such as rising fuel prices and goods vehicle restriction policies still need to be considered in further analysis.

5. Conclusion

The findings of this study on investment feasibility in the textile chemical distribution sector yield several important insights. Demand forecasting through seasonal decomposition revealed a stable trend with recovery expected after 2024, supported by a forecasting accuracy of 12.4% MAPE. Comparing alternatives shows that rental costs escalate significantly—around 15% annually—imposing long-term financial pressure, whereas truck ownership requires a substantial initial outlay but ensures more predictable operating expenses. Financial analysis further demonstrates that, despite negative NPVs for both alternatives, ownership yields a relatively better value, with capital recovery achieved in 4.5 years, still within the truck's eight-year economic life. The estimated IRR of 16.21% exceeds the company's 15% MARR, while a MIRR of 15.9% strengthens the evidence of financial viability. Strategically, owning a truck not only reduces dependency on third parties but also enhances reliability and resilience in the supply chain. Consequently, truck purchase represents a superior and more sustainable choice compared with continued leasing.

References

1. S. B. Bhandari, "Discounted Payback Period—A Viable Complement to Net Present Value for Projects with Conventional Cash Flows," *The Journal of Cost Analysis*, vol. 7, no. 1, pp. 43–53, 1989, doi: 10.1080/08823871.1989.10462376.
2. G. Barnes and P. Langworthy, "Per-mile costs of operating automobiles and trucks," *Transportation Research Record*, vol. 1864, no. 1, pp. 64–71, 2004, doi: 10.3141/1864-10.
3. H. Bierman and S. Hass, "The Payback Method Revisited," *The Engineering Economist*, vol. 34, no. 4, pp. 275–283, 1989, doi: 10.1080/00137918908902905.
4. J. Bilau and J. St-Pierre, "Microcredit repayment in a European context: Evidence from Portugal," *The Quarterly Review of Economics and Finance*, 2018, doi: 10.1080/0015198X.2018.1470902.
5. A. Engholm, A. Pernestal, and I. Kristofferson, "Cost analysis of driverless truck operations," *Transportation Research Record*, vol. 2674, no. 9, pp. 616–627, 2020, doi: 10.1177/0361198120930228.
6. L. Gan, C.-Y. C. Lin, and S. Pouliot, "Vehicle Cost per Mile and the Economics of Automobiles," *Transportation Economics*, vol. 22, no. 3, pp. 45–61, 2003.
7. N. D. Go and O. F. Jin, "Analisis kelayakan finansial terhadap pembangunan infrastruktur pada dua port di tepi Sungai Barito – Kalimantan Tengah," *Jurnal Teknik Sipil*, vol. 27, no. 2, pp. 169–176, 2020, doi: 10.5614/jts.2020.27.2.7.
8. A. Gunardi, R. Suryadi, and L. Rahayu, "Investment Feasibility Analysis: Concepts and Practical Application in Business Decision," *Journal of Business and Management Research*, vol. 12, no. 2, pp. 55–68, 2022.
9. E. Hermawan and U. Sudjadi, "Integrated nuclear-renewable energy system for industrialization in West Nusa Tenggara Province, Indonesia: Economic, potential site, and policy recommendation," *International Journal of Energy Economics and Policy*, vol. 12, no. 4, pp. 146–159, 2022, doi: 10.32479/ijeep.13067.
10. R. J. Hyndman and Y. Khandakar, "Automatic time series forecasting: The forecast package for R," *Journal of Statistical Software*, vol. 27, no. 3, pp. 1–22, 2008, doi: 10.18637/jss.v027.i03.
11. M. Ibrahim and A. Rinienta, "Analisis Investasi Armada Transportasi dan Faktor-faktor Penentunya," *Jurnal Logistik dan Transportasi*, vol. 5, no. 1, pp. 34–42, 2020.
12. H. E. Kierulff, "MIRR: A better measure," *Business Horizons*, vol. 51, no. 4, pp. 321–329, 2008, doi: 10.1016/j.bushor.2008.02.005.
13. F. Lestari, A. Nugroho, and R. Pratiwi, "Forecasting Demand Using Decomposition Method in Time Series Analysis," *Indonesian Journal of Statistics and Its Applications*, vol. 3, no. 2, pp. 99–108, 2019.
14. S. Makridakis and M. Hibon, "The M3-Competition: Results, conclusions and implications," *International Journal of Forecasting*, vol. 16, no. 4, pp. 451–476, 2000, doi: 10.1016/S0169-2070(00)00057-1.
15. G. A. Ndubizu, "A Comparative Analysis of Payback and Discounted Payback Methods," *The Engineering Economist*, vol. 45, no. 1, pp. 1–14, 2000, doi: 10.1080/00137910008967546.
16. A. Pranoto, H. Hermawan, and N. Albart, "A systematic literature review: Business feasibility analysis using Net Present Value (NPV) and Internal Rate of Return (IRR) methods in the automotive industry," *Jurnal Indonesia Sosial Sains*, vol. 6, no. 1, pp. 171–184, 2025, doi: 10.59141/jiss.v6i1.1577.
17. R. Ridwan Margana and O. Kusumah, "Analisis Kelayakan Investasi Truk Menggunakan Net Present Value, Payback Period, dan Internal Rate of Return pada PT Swisstex Naratama Indonesia," *Journal of Technology and Engineering*, vol. 2, no. 2, pp. 87–98, 2024, doi: 10.59613/journaloftechnologyandengineering.v2i2.161.
18. M. V. Sokolov, "NPV, IRR, PI, PP, and DPP: A unified view," *arXiv preprint*, 2023, doi: 10.48550/arXiv.2302.02875.
19. T. A. Weber, "On the (non-)equivalence of IRR and NPV," *Journal of Mathematical Economics*, vol. 53, pp. 74–91, 2014, doi: 10.1016/j.jmateco.2014.03.006.
20. S. Yard, "Developments of the payback method," *International Journal of Production Economics*, vol. 67, no. 2, pp. 155–167, 2000, doi: 10.1016/S0925-5273(00)00003-7.