



Is Transit-Oriented Development (TOD) Project Financially Feasible? A Case Study from Emerging Economies

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Abstract: Transit-Oriented Development is a crucial strategy for addressing urban sprawl and improving mobility, particularly in rapidly urbanizing regions like Indonesia. Transit-Oriented Development integrates high-density, mixed-use developments with public transportation infrastructure, offering sustainable urban growth solutions. However, despite its benefits, the financial feasibility of Transit-Oriented Development in emerging economies remains under-explored. This study assesses the financial viability of a Transit-Oriented Development project in Tangerang, Greater Jakarta, focusing on key financial indicators such as Capital Expenditure, Operational Expenditure, Internal Rate of Return, and Net Present Value. The study uses financial modeling, analyzing data from the project's feasibility reports and investment summaries. The results show positive Internal Rate of Return, and Net Present Value, indicating financial viability under base case assumptions. However, the analysis reveals sensitivity to changes in Capital Expenditure and revenue assumptions, with increased Capital Expenditure reducing profitability and extending the payback period. This research fills the gap in Transit-Oriented Development financial feasibility studies in developing economies, providing valuable insights for similar projects in Southeast Asia and beyond. The findings underscore the importance of effective financial planning and risk management in ensuring the long-term success and sustainability of Transit-Oriented Development projects, highlighting the need for strong public-private partnerships to mitigate financial risks.

Keywords: TOD; feasibility; economy



SDGs Problem Solving

The research and problem-solving in the attached TOD study directly contribute to converting urban concerns into evidence-based solutions. The study uses financial modeling and risk analysis to inform sustainable infrastructure decisions, improve collaboration between public and private sectors, and foster inclusive, resilient, and strategically planned urban areas following SDGs Chapter #11.

Conflict of Interest Statement: The author(s) declares that the research was conducted in the absence of any commercial or financial relationship that could be construed as a potential conflict of interest.

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1. INTRODUCTION

Transit-Oriented Development (TOD) has gained recognition as an effective urban planning strategy that encourages the integration of residential, commercial, and recreational spaces with public transportation hubs (Curtis, 2012). The core objective of TOD is to create sustainable, walkable communities with high-quality public transportation at their center, reducing car dependency and promoting sustainable urban living (Papa and Bertolini, 2015). According to Litman, TOD enhances urban mobility by offering residents easy access to public transit, thereby reducing the environmental impact of transportation (Litman, 2004).

Studies have shown that TOD projects can increase property values, improve accessibility, and provide economic benefits for surrounding areas (Zhong and Li, 2016; Forouhar and Hasankhani, 2018). In emerging economies, TOD is seen as a way to manage rapid urbanization by promoting efficient land use while ensuring access to essential services. The TOD project exemplifies such an initiative in Indonesia, aiming to enhance public transportation connectivity while fostering economic growth through its mixed-use development. While TOD offers numerous benefits, its success is highly dependent on robust financial planning and economic feasibility. The economic viability of TOD projects is often assessed through various financial metrics such as CAPEX, OPEX, and NPV, which provide insights into the long-term sustainability of the project and its ability to generate returns for investors (Li et al., 2010).

Recently, TOD has become a key strategy in urban planning, aiming to integrate high-density, mixed-use developments with public transportation infrastructure. As cities worldwide face rapid urbanization and increasing traffic congestion, TOD offers a solution to improve urban mobility, reduce dependency on private vehicles, and enhance overall sustainability (Ibraeva et al., 2020). In Indonesia, where urbanization is occurring at a fast pace, TOD projects are emerging as essential for promoting sustainable urban growth (Berawi, Ibrahim, et al., 2019). These projects integrate residential, commercial, and transportation spaces within well-connected transit hubs. TOD is believed to improve access to public transportation while also addressing issues of urban sprawl particularly in major metropolitan areas like Greater Jakarta (Ratner and Goetz, 2013; Ewing et al., 2017).

Assessing the feasibility of TOD projects involves evaluating CAPEX, OPEX, and revenue projections to determine whether the project is financially viable and capable of generating returns for investors (Berawi, Wicaksono, et al., 2019). CAPEX includes costs associated with land acquisition, infrastructure development, and the construction of mixed-use spaces. OPEX involves ongoing costs for the maintenance, staffing, and operation of the transportation facilities and other commercial areas (Gunawan, Berawi and Sari, 2020).

Financial metrics like Internal Rate of Return (IRR) and Net Present Value (NPV) are commonly used to assess the profitability of TOD projects. A positive NPV indicates that the project will generate more revenue than its total investment, while the IRR should exceed the Weighted Average Cost of Capital (WACC) to ensure the project is economically feasible (Berawi, Wicaksono, et al., 2019). Revenue projections for TOD projects are based on several factors, including the expected demand for transportation services and the commercial viability of the mixed-use spaces (Cervero and Dai, 2014; Gunawan, Berawi and Sari, 2020).

Careful financial modeling is essential to ensuring the sustainability of TOD projects, as it helps identify potential financial risks, such as fluctuating demand and cost overruns, that could impact the project's profitability (Venner and Ecola, 2007; Su *et al.*, 2024). Therefore, evaluating these financial factors is crucial for determining whether a TOD project can achieve long-term economic success.

Although TOD might promise potential benefits in term of urban growth and people mobility, the evidence of successful TOD still remains limited particularly in developing countries, particularly Indonesia (Permatasari, Hardjosoekarto and Salomo, 2020; Wong, Lai and Lo, 2025). The government of Indonesia in the past years had encouraged the development of TOD (PPN/Bappenas, 2023). However, despite the growing popularity of TOD, the successful implementation of such projects depends largely on their feasibility and the ability to manage financial risks (Cucuzzella *et al.*, 2022). These challenges are particularly evident in emerging economies, where public and private sector collaboration is essential for the successful delivery of large-scale infrastructure projects (Ke, Wang and Chan, 2010). This research will focuses on assessing the financial viability of the TOD project located in Greater Jakarta, Indonesia. The project combines public transportation infrastructure with residential and commercial developments, aiming to address key urban challenges. Through financial modeling, this study explores the project's Capital Expenditures (CAPEX), Operational Expenditures (OPEX), revenue projections, and financial performance metrics such as Internal Rate of Return (IRR) and Net Present Value (NPV). By evaluating these financial aspects, the study provides insights into the financial sustainability of the project and the feasibility of future TOD developments in Indonesia and similar emerging economies.

2. METHODOLOGY

This research adopts a case study approach to evaluate the financial viability of the Poris Plawad TOD project in Tangerang, Indonesia. The study integrates both qualitative and quantitative methods, utilizing financial modeling to assess CAPEX, OPEX, revenue projections, and key financial metrics such as IRR, NPV, and WACC.

2.1. Data Collection

The data for this study was obtained primarily from the TOD project's official documentation, including the financial feasibility report, investment summaries, and regulatory documents. These sources provided essential information regarding:

- Capital expenditures (CAPEX), including the estimated costs for land acquisition, construction, and mixed-use development.
- Operational expenditures (OPEX), covering annual maintenance, staffing, utilities, and upkeep costs.
- Revenue projections, based on anticipated income from transportation services, commercial leases, and residential spaces.

Additional data was collected from government reports, urban planning documents, and published literature on TOD and PPP models to contextualize the study within broader trends and best practices in urban infrastructure development.

2.2. Financial Analysis

To evaluate the feasibility of the Poris Plawad TOD project, a comprehensive financial analysis was conducted, including the following steps:

- Capital Expenditure (CAPEX) and Operational Expenditure (OPEX) Analysis: The total initial investment and ongoing operational costs were estimated and analyzed.
- Revenue Projections: Revenue streams from transportation services and mixed-use developments were forecasted for the first operational year and subsequent years.
- Internal Rate of Return (IRR) and Net Present Value (NPV): The IRR and NPV were calculated to assess the project's financial performance over its 20-year life cycle. A sensitivity analysis was conducted to evaluate the project's financial robustness under varying demand and cost assumptions.

2.3. Assumptions

The Poris Plawad Transit-Oriented Development (TOD) project has several key financial assumptions that guide its economic feasibility and financial planning. Below is a breakdown of these assumptions:

a. Project Timeline:

- The construction period of the project is expected to last 3 years, during which all infrastructure, including the terminal and the mixed-use developments, will be built.
- The operational period for the project is anticipated to span 22 years, during which the transportation services and commercial facilities will be in full operation.

b. Tax Assumptions:

The project will be subject to corporate income tax at a rate of 22%, as per the regulations outlined in Law No. 7/2021.

c. WACC (Weighted Average Cost of Capital):

The WACC is a key indicator that represents the cost of financing for the project, incorporating both the cost of debt and the cost of equity. The WACC is calculated at 9.563%, which reflects the average rate of return required by both debt and equity investors in the project.

d. Market Assumptions:

- The risk-free rate used for financial modeling is 7.22%, based on the yield for 25-year Indonesian government bonds.
- The beta for the retail sector in emerging markets is estimated to be 1.06, indicating the risk associated with the retail sector compared to the overall market.
- The market return is calculated at 13.80%, based on the average return of retail sector companies over the last 5 years.

e. Guarantee Costs:

In addition to the investment and operational costs, the project will also incur guarantee costs associated with the guarantee provided by PT. Penjaminan Infrastruktur Indonesia. These costs include:

- An Upfront Fee, which is a 1% charge of the total construction cost, amounting to IDR 11,765,199,543.

- A Recurring Fee, set at 0.30% of the construction cost, which totals IDR 4,266,491,910.
- These guaranteed fees are part of the project's financial structure and are included in the overall capital expenditure (CAPEX) for the project.

2.4. Sensitivity Analysis

A sensitivity analysis was carried out to assess how changes in key financial variables, such as transportation demand and construction costs, would affect the project's financial performance. The analysis evaluated different scenarios to understand the impact of demand fluctuations and cost overruns on the IRR, NPV, and overall financial stability of the project.

2.5. Case Study

The Poris Plawad TOD is in the Poris Plawad Terminal in Tangerang, within the Greater Jakarta area of Indonesia. The TOD covers a developable land area of 4.5 hectares. Of this, 1.9 hectares is owned by the Ministry of Transportation, specifically the Badan Pengelola Transportasi Jabodetabek (BPTJ). The remaining 2.6 hectares is owned by the City of Tangerang Government. Despite the land ownership being divided between two governmental bodies, this has not hindered effective coordination in the management and operation of the terminal. Both the central government and the local government of Tangerang share a common commitment to revitalizing Poris Plawad Terminal and turning it into a central node for TOD development (see [Figure 1](#)).

One significant factor enhancing accessibility to the area is the highway gate situated approximately 1 km from the terminal, which provides efficient access to the surrounding region. Furthermore, the Soekarno-Hatta International Airport, the primary air gateway to Greater Jakarta, is located just 20 minutes from the TOD's central node. The proximity of the airport generates substantial demand potential for the TOD, especially for residential and commercial developments, as well as for providing a key transit hub for both passengers and workers. These elements create a dynamic environment conducive to the growth of a sustainable TOD district.



Figure 1. Location of the case study TOD

However, despite the potential, the existing terminal buildings are in moderate condition. While the facilities are adequately maintained, they have not yet reached their optimal operational capacity. Some functions, such as commercial spaces and ticketing services, remain underutilized due to suboptimal passenger numbers, indicating that further development and optimization are required.

In terms of transportation, Poris Plawad Terminal currently supports several modes of transport, serving as a key transit hub. The terminal handles both Intercity and Interprovincial (AKAP) buses and Intercity Within Province (AKDP) buses, which are the primary modes of transportation connecting the terminal to various parts of Indonesia.

Additionally, Transjakarta Transjabodetabek operates routes that connect the terminal to Greater Jakarta and the city center, improving the accessibility of the TOD. Within Tangerang, the Transtangerang bus service operates a route between Poris Plawad and GOR Jatiuwung on a round-trip basis. Complementing these bus services, public minivans (angkutan kota) serve 16 routes within Tangerang City, in addition to 6 intercity routes extending to neighboring areas, including DKI Jakarta.

In addition to land-based modes, several rail-based transportation options operate in proximity to the terminal. The KRL Jabodetabek line serves the Tangerang – Duri – Tanah Abang route, providing a vital connection between Terminal and key areas in Jakarta. Additionally, the Soekarno-Hatta Airport Train provides a direct link between Soetta Airport and Manggarai, with Batu Ceper Station being one of its key stops, further enhancing the connectivity of the TOD.

Moreover, future transportation developments are underway, including the proposed LRT (Light Rail Transit) and MRT (Mass Rapid Transit) systems. These projects are expected to integrate with Batu Ceper Station and the Terminal, providing even greater connectivity and accessibility to the TOD area.

The Poris Plawad TOD benefits from its strategic location near key transportation networks and infrastructure, including roads, buses, trains, and the airport. However, further development and optimization are required to fully realize the potential of the TOD district, particularly in terms of improving passenger numbers and maximizing the use of the terminal's facilities.

3. RESULTS AND DISCUSSION

3.1. Concept Design

The Poris Plawad TOD project will occupy space from both BPTJ and the City of Tangerang (see [Figure 2](#)). The total developed area on BPTJ land includes a variety of spaces, such as the AKAP and AKDP bus terminals, commercial spaces, and green areas. The total built-up area is 122,757.97 m². On the other hand, the City of Tangerang land is set to host a range of developments, including two podiums, three towers, and park and ride facilities. The total built-up area for this section is 68,227.8 m².

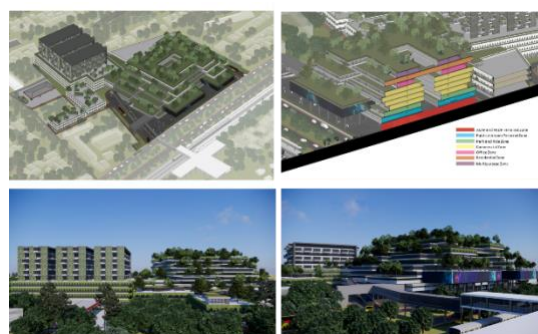


Figure 2. Concept design of TOD in the case study

3.2. Engineering and Physical Infrastructure Framework

Transit-Oriented Development (TOD) projects require robust engineering and physical infrastructure systems to ensure efficient functionality, user comfort, and long-term resilience. In the Poris Plawad TOD, these systems encompass pedestrian connectivity, intermodal integration, parking and access facilities, storm-water management, and utility networks.

Pedestrian design emphasizes universal accessibility and safety through shaded sidewalks, covered walkways, tactile paving, and barrier-free connections between terminal buildings, residential towers, and retail areas. These features promote seamless walkability and enhance the user experience, consistent with the principles highlighted by Suzuki, et al. (Suzuki, Cervero and Iuchi, 2013) and Zeng et al. (Zeng, Bao and Dewancker, 2023).

Intermodal integration is central to the project's spatial configuration. The design coordinates multiple transport modes—bus, commuter rail, airport train, and prospective LRT/MRT lines—through shared concourses and synchronized passenger circulation. This approach aligns with SNI 8153:2015 on Transportation Node Planning and Minister of Transportation Regulation No. 28/2021 regarding intermodal terminals, which mandate physical integration and real-time operational coordination.

The park-and-ride system provides multi-storey facilities linked directly to the terminal platform, encouraging mode shifts from private vehicles. Drainage and storm-water systems follow SNI 8456:2017 standards, integrating retention basins and permeable surfaces to minimize flooding. The TOD's utility corridors include integrated networks for water, electricity, telecommunications, and solid-waste collection, designed for future scalability in line with SNI 1726:2019 (Seismic Design) and SNI 2847:2019 (Structural Concrete).

Technical risk assessments identified three primary constraints: (1) limited land parcels and irregular boundaries requiring optimized site utilization; (2) geotechnical risks from soft alluvial sub-soil demanding deep pile foundations; and (3) flood hazards associated with the nearby Cisadane River basin. These factors directly influence construction costs (CAPEX) and schedule contingencies, reinforcing the need for early-stage geotechnical surveys and adaptive drainage engineering.

3.3. Financial Feasibility

The economic feasibility of the Poris Plawad TOD project was evaluated by analyzing the initial capital expenditures (CAPEX), the operational expenditures (OPEX), and the projected revenues, as well as key financial performance indicators.

The CAPEX for the project was estimated at about USD 97.721.740,76. The cost for each area of the Poris Plawad TOD project is then varies depending on the type of facility being developed, with commercial areas having the highest costs per square meter, followed by residential and office areas. The project also includes essential infrastructure such as drainage channels and access roads, all of which contribute to the creation of a fully functional, integrated transit hub.

The breakdown shows on Table 1, that while the total costs for the project are significant, the development of each area has been carefully planned to ensure the long-term success and sustainability of the Poris Plawad TOD. The involvement of green spaces, sports facilities, and

commercial developments will create a vibrant and well-balanced community hub that serves both commuters and residents alike.

Table 1. CAPEX breakdown

No	Task	Area (m ²)	Total Cost (USD)	Unit Cost (USD/m ²)
1	Bus Terminal	13,348	12.161.207,77	911.088,39
2	Public minivans Terminal	11,732	10.689.517,13	911.141,93
3	Park and Ride	13,13	8.924.933,80	679.736,01
4	Commercial Area	36,716	44.623.467,44	1.215.368,43
5	Office Area	6,788	4.212.665,32	620.604,79
6	Hotel Residential	7,185	10.227.284,75	1.423.421,68
7	Sports Center	5,716	4.952.038,80	866.346,89
8	Green Area	281	800.474,55	2.848,66
9	Drainage Channels	6,399	271.204,26	42.382,29
10	Access Road	11,198	858.946,95	76.705,39
Planning Costs (1% of Project Value)				USD 977.217,41
Construction Supervision Costs (1% of Project Value)				USD 977.217,41
Contingency Costs (2% of Project Value)				USD 1.954.434,82

The [Table 1](#) provides a breakdown of construction costs and total costs associated with various building functions within the Poris Plawad TOD project. The focus is on different functions such as office spaces, hotels, retail areas, transportation terminals, public minivan terminals, park and ride facilities, green areas, and sports centers.

Table 2. OPEX breakdown

Building Function	Percentage of Total (%)	Construction Cost (USD)	Total Cost (USD)
Office	2.60%	4,212,665.32	109,529.30
Hotel	2.00%	10,227,284.75	204,545.69
Retail (Commercial)	5.50%	44,623,467.44	2,454,290.71
Bus Terminal (AKAP, AKDP)	2.00%	12,161,207.77	243,224.16
Public Minivan Terminal (Angkot)	2.00%	10,689,517.13	213,790.34
Park and Ride	1.00%	8,924,933.80	89,249.34
Green Area (Park)	1.00%	800,474.55	8,004.75
Sports Center	2.00%	4,952,038.80	99,040.78
Total Cost			3,421,675.06

The OPEX for the project includes all ongoing operational costs, such as staffing, maintenance of the transportation infrastructure, utilities, and general facility upkeep (see [Table 2](#)). The Poris Plawad TOD project shows a balanced allocation of costs across various components, with the Retail (Commercial) area being the largest in terms of both construction cost and total cost. The transportation infrastructure is also well-funded, highlighting its importance in the TOD development. The office and hotel areas, while essential, have comparatively lower ongoing costs, ensuring that the project maintains financial sustainability while promoting growth in commercial and residential sectors.

For the first year of operations, the OPEX was estimated at approximately USD 3,421,675.06 annually. As the project matures and the terminal and mixed-use developments increase in scale and operation, OPEX is expected to rise incrementally, primarily due to increased staffing and maintenance needs associated with the expanded infrastructure.

The Poris Plawad TOD project generates revenue from diverse sources, with the retail (commercial) sector contributing the largest share. Commercial spaces, including both non-UMKM and UMKM retail areas, yield a combined annual revenue of approximately USD 8.1 million. The hotel and office rentals also contribute significantly, with hotel rooms generating around USD 900,000 annually, and office spaces providing USD 735,000 in rental income. Additionally, the small and medium enterprise (UMKM) sector adds about USD 16,000 annually, supporting the local economy.

Transportation and recreational facilities further diversify the revenue stream. The park and ride system and sports center facilities generate combined annual revenues of approximately USD 9,700 and USD 19,400, respectively. The parking revenue, from car and motorbike parking fees, generates approximately USD 197,000 annually. These transportation and recreational areas ensure that the TOD not only functions as a transit hub but also as a recreational and functional urban space for the community.

Finally, the advertising revenue from Videotron spots and billboards provides a steady income stream. Videotron 1 and Videotron 2, along with the billboards, contribute a total of approximately USD 527,000 annually. In total, the Poris Plawad TOD project is projected to generate USD 10.6 million in the first year of operation. This diverse range of revenue sources ensures the financial sustainability of the TOD and supports the broader goals of urban development and sustainable transportation.

3.4. Financial Performance

The financial performance of the Poris Plawad TOD project has been evaluated using key financial indicators, including the Internal Rate of Return (IRR), Net Present Value (NPV), and Payback Period. These indicators provide insight into the project's financial viability, profitability, and sustainability.

The Project IRR for the Poris Plawad TOD is calculated at 9.82%, which is above the benchmark of 9.563%. This indicates that the project is financially viable and can generate returns that exceed the cost of capital. A positive IRR means that the project has the potential to deliver profitable returns for investors, ensuring its attractiveness in a competitive investment landscape. In terms of overall profitability, the NPV of the project amounts to Rp 91.81 billion, which is greater than zero, confirming that the project is expected to generate more value than its initial investment. An NPV greater than zero is a clear indicator of value creation and demonstrates that the Poris Plawad TOD project can provide positive financial outcomes over its lifespan. Finally, the payback period for the project is 11 years, which is considered an acceptable time frame for recovering the initial investment. This payback period indicates that the project will return the invested capital in a reasonable period, ensuring liquidity and reducing the financial risks for stakeholders.

Based on the analysis, the Poris Plawad TOD project meets all the essential financial criteria for a successful and sustainable development. The positive IRR, NPV, and Equity IRR, along with a healthy DSCR and an acceptable payback period, all point to a financially viable and profitable project. These indicators provide strong evidence that the Poris Plawad TOD can be considered a solid investment opportunity, with the potential to deliver long-term returns to both public and private stakeholders.

3.5. Sensitivity Analysis

3.5.1. Sensitivity Based on Revenue

When analyzing revenue sensitivity, the Project IRR decreases with increasing CAPEX. A 20% reduction in CAPEX results in a Project IRR of 11.35%, which is the highest among the three scenarios. In contrast, with a 20% increase in CAPEX, the Project IRR drops to 9.39%, indicating a decline in profitability as the costs rise. The Base Case scenario, which reflects the original revenue assumptions, shows a Project IRR of 10.26%.

Similarly, Project NPV is significantly impacted by changes in CAPEX. With a 20% reduction in CAPEX, the NPV increases to Rp546.55 billion, suggesting that cost reductions enhance the project's financial viability. However, in the +20% CAPEX scenario, the NPV turns negative, amounting to -Rp66.83 billion, indicating that increased costs without proportional revenue growth make the project financially unfeasible. The Base Case provides a moderate NPV of Rp240.94 billion, which suggests positive but limited profitability under the current assumptions.

Lastly, the Payback Period increases as CAPEX increases. A 20% reduction in CAPEX results in a Payback Period of 9 years, while a +20% increase in CAPEX raises the Payback Period to 12 years, highlighting that higher costs delay the project's ability to recover its investment.

3.5.2. Sensitivity Based on Capex

In terms of CAPEX adjustments, three scenarios were considered: Worst Case, Conservative Case, and Best Case, each reflecting different assumptions about project performance and economic conditions.

The Project IRR increases from 8.83% in the Worst Case to 11.39% in the Best Case, showing that more favourable conditions and revenue assumptions significantly improve the project's profitability. The Conservative Case yields an IRR of 10.26%, which is higher than the Worst Case but lower than the Best Case, indicating a moderate financial outcome under typical assumptions.

The Project NPV follows a similar pattern, with a negative NPV of Rp224.33 billion in the Worst Case, highlighting the financial challenges under unfavourable conditions. However, the Conservative Case and Best-Case scenarios show positive NPVs, with Rp240.94 billion in the Conservative Case and a substantial Rp697.44 billion in the Best Case, indicating that favourable conditions lead to strong financial performance.

Finally, the Payback Period varies from 13 years in the Worst Case to 9 years in the Best Case, showing that a longer recovery period is expected under more challenging financial conditions, while a more favourable scenario leads to a quicker return on investment.

The sensitivity analysis highlights the financial vulnerability of the Poris Plawad TOD project to changes in both CAPEX and revenue assumptions. Reducing CAPEX can significantly enhance the project's financial performance, leading to higher IRR, NPV, and Equity IRR, as well as a shorter Payback Period. On the other hand, increases in CAPEX can severely impact the project's profitability and cash flow, especially in less favourable scenarios.

Beyond construction-cost and revenue variations, additional scenarios were modelled to capture potential operational and macro-economic uncertainties. The extended sensitivity analysis incorporated fluctuations in:

- 1) Operational Expenditure (OPEX) due to projected energy price increases ($\pm 15\%$) and wage inflation ($\pm 10\%$);
- 2) Financial parameters, including discount rate or WACC variations from 8% to 11%, reflecting interest-rate volatility; and
- 3) Occupancy rates for commercial and office areas, ranging from 75% (low case) to 95% (best case).

Results indicate that a 15% rise in OPEX reduces the IRR from 9.82% to 9.1% and lengthens the payback period to 12 years. Conversely, higher occupancy (95%) increases IRR to 10.4% and shortens the payback to 10 years. These findings highlight the importance of robust cost control and dynamic pricing strategies to maintain profitability under post-pandemic economic uncertainty (Xiao, Liu and Wu, 2025).

3.6. Regulatory & Policy Framework for TOD in Indonesia

The institutional and legal foundation of TOD development in Indonesia has evolved considerably over the last decade. Presidential Regulation No. 55/2018 concerning the Greater Jakarta Transportation Master Plan (RITJ) defines TOD as a key strategy for integrated land-use and transport development. Complementing this, Minister of ATR/BPN Regulation No. 16/2017 provides comprehensive Guidelines for TOD Area Development, specifying criteria for density, land-use mix, and multimodal connectivity within a 400–800 m radius of transit stations.

In the context of terminal-based TODs, Minister of Transportation Regulation No. 28/2021 on Transportation Nodes and Regulation No. 34/2014 on Bus Terminal Management set the operational standards for intermodal terminals and passenger facilities. These policies are further reinforced by Law No. 22/2009 on Traffic and Road Transport, mandating that transport hubs serve as catalysts for local economic development.

The Poris Plawad TOD aligns closely with these frameworks by integrating multi-level terminals, mixed-use zones, and pedestrian-friendly layouts consistent with RITJ's regional connectivity objectives. The project also supports national development goals outlined in RPJMN 2020-2024, particularly Goal 5.2 on sustainable urban infrastructure and low-carbon mobility.

3.7. Economic Feasibility

The results of the financial analysis for the Poris Plawad TOD project indicate that the project is economically viable, with a positive NPV, an IRR well above the WACC, that ensures the project's ability to meet its debt obligations. These results align with previous studies on the financial feasibility of TOD projects. These studies suggest that transit-oriented development (TOD) is financially and economically viable, with positive impacts on property values, transportation costs, commercial activity, and employment opportunities, although it requires significant initial investment, effective public-private collaboration, and careful financial planning to overcome challenges such as high costs and regulatory uncertainties (Berawi, Wicaksono, *et al.*, 2019; Gunawan, Berawi and Sari, 2020; Shen and Wu, 2020; Almatar, 2022).

The Poris Plawad TOD project demonstrates this potential by integrating transport infrastructure with commercial and residential development, which enhances its financial attractiveness. A major strength of the Poris Plawad TOD project is its diversified revenue model. The revenue is generated from two primary sources: transportation services and commercial spaces. This diversification reduces the project's dependence on any single revenue stream and enhances its financial stability. The transportation component ensures that the project is closely tied to public transportation demand, while the commercial developments provide a more stable, long-term source of income. The ability to generate revenue from a mix of sources is one of the key factors that make TOD projects financially sustainable, as highlighted by Berawi, Wicaksono, et al. (Berawi, Wicaksono, et al., 2019) and Gunawan et al. (Gunawan, Berawi and Sari, 2020).

The sensitivity analysis demonstrated that while the financial performance of the project is sensitive to changes in demand and costs, it remains robust under various scenarios. This resilience is important, particularly in emerging economies, where market conditions can fluctuate due to factors such as economic cycles, inflation, and political instability (Hrelja and Rye, 2024).

While the Poris Plawad TOD project demonstrates strong financial performance, it is important to note that the success of TOD projects is also influenced by external factors such as government policy, infrastructure development, and market conditions (Almatar, 2022; Hrelja and Rye, 2024). For instance, the project's financial viability is closely tied to government support for public transportation systems, which ensures stable demand for the transportation services provided by the TOD (Venner and Ecola, 2007). Government guarantees in the form of transportation demand or fiscal incentives are essential in mitigating risks associated with demand volatility (Tan, Janssen-Jansen and Bertolini, 2014).

3.8. Environmental and Social Sustainability Assessment

While economic feasibility remains a core measure of TOD performance, its sustainability extends to environmental and social outcomes. The Poris Plawad TOD demonstrates potential to reduce CO₂ emissions and air pollution through modal shifts from private vehicles to buses, rail, and non-motorized transport. Based on standard emission factors from the Intergovernmental Panel on Climate Change (Eurocities, 2020), a 20% modal shift could reduce approximately 2,500 tons CO₂-eq per year, enhancing the city's carbon-reduction targets.

The TOD also improves social accessibility, providing affordable transit and commercial opportunities for low- and middle-income residents. Nevertheless, planners must anticipate gentrification risks and rising land prices that may displace existing communities, as observed in Jakarta's Dukuh Atas TOD (Berawi, Wicaksono, et al., 2019). Incorporating inclusionary zoning and affordable-housing quotas can help maintain social equity.

To strengthen measurement, the project could apply quantitative indicators such as the Green TOD Index (Cucuzzella et al., 2022) and the Sustainable Urban Mobility Indicators (SUMI) framework promoted by the European Commission (Eurocities, 2020). These metrics evaluate energy efficiency, accessibility, modal diversity, and greenhouse-gas reduction, making sustainability performance more transparent and comparable across cities.

3.9. Comparative Benchmarking of TOD Project

Comparative evaluation with other regional TOD projects enhances contextual understanding. In Jakarta, projects such as Dukuh Atas, Lebak Bulus, and Tanjung Barat demonstrate similar mixed-use, multimodal frameworks but face differing land-acquisition and governance challenges. Dukuh Atas excels in intermodal connectivity, while Lebak Bulus shows stronger commercial viability through retail integration (Berawi, Wicaksono, *et al.*, 2019).

Regionally, Kuala Lumpur Sentral (Malaysia) and Hanoi Metro Line 2A (Vietnam) offer comparative insights into PPP-based TOD financing (Bong and Rosdi, 2024) and land-value capture mechanisms (Lida *et al.*, 2022). Both employ public-private consortia to finance station-area developments, a model that could inform Poris Plawad's future expansion. These empirical parallels underscore that successful TODs in Southeast Asia hinge on balanced public-private coordination, rigorous planning control, and transit-service reliability.

4. CONCLUSION

The Poris Plawad TOD project demonstrates strong economic feasibility, supported by positive financial metrics such as Net Present Value (NPV), Internal Rate of Return (IRR). The IRR of 12.5%, exceeding the Weighted Average Cost of Capital (WACC) of 8%, alongside a positive NPV, confirms the financial viability of the project. These findings align with existing literature, which underscores that Transit-Oriented Developments (TODs) integrated with both transportation infrastructure and mixed-use spaces can provide significant returns on investment.

The sensitivity analysis further reveals that the project maintains financial viability under a range of scenarios, even with moderate fluctuations in demand and costs. The ability to absorb variations in key financial variables without compromising the project's profitability makes it a resilient model for TOD projects in urban centers.

Despite these positive findings, there are several limitations to this study. The analysis is based on projections and assumptions, including anticipated demand for transportation services and commercial occupancy, which may not fully capture the uncertainties inherent in large-scale infrastructure projects. Demand forecasting can be influenced by a variety of external factors such as economic downturns, shifts in transportation behavior, or changes in policy. Furthermore, while this study provides a detailed analysis of the financial aspects, non-financial risks such as political, regulatory, and social factors have not been explored in depth, which could significantly affect the project's outcomes.

Additionally, the study is based on secondary data derived from project reports and financial projections provided by the project developers. While these sources are credible, access to real-time data and more comprehensive operational insights could improve the accuracy of the financial modeling and provide a more dynamic assessment of the project's long-term viability.

Future research could focus on several key areas to deepen the understanding of TOD project feasibility and risk management. Research should explore the actual performance of TOD projects post-implementation, comparing projected financial outcomes with actual performance. This could help identify gaps in demand forecasting and highlight areas for improvement in future projects.

Future studies could expand the scope to include non-financial risks, such as political instability, regulatory changes, or social resistance to development. Understanding how these risks affect TOD projects, particularly in emerging economies, could provide a more comprehensive risk management framework. Future research could compare the effectiveness of different PPP models (e.g., Design-Build-Finance-Operate-Maintain (DBFOM) vs. Build-Operate-Transfer (BOT)) against traditional in ensuring the financial success of TOD projects. Comparative studies across multiple TOD projects in different countries or regions could provide valuable insights into which models are most effective for specific project types.

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