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Exploring Level of Effectivity on Public Transportation as One of Transportation Demand Management Strategy

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Abstract

Existing road and traffic management infrastructure could not substantially accommodate the sudden surge in vehicle ownership and traffic congestion. Additionally, congestion in developing nation is additionally linked to restricted road infrastructure and a shortage of resources for traffic management. To solve the problems, experts and literature proposed Transportation Demand Management as a strategy that one of the objectives is to establish effective public transportation system. In this research, we aim to explore the effectiveness of Trans Metro Pasundan performance as one of TDM implementation in Bandung, Indonesia by examining operational measurements, such as: fleet number, vehicle utilization, load factor, accident rates; and financial measurements, such as: revenue per kilometre and cost per kilometre. As a result, Dipatiukur - Jatinangor via Toll route operates with the highest number of vehicles, Kota Baru Parahyangan - Alun-Alun Kota Bandung and Baleendah - BEC routes exhibit strong load factors, Leuwi Panjang - Soreang route's strong revenue performance. Hence, the transportation service provider should continue to focus on understanding route-specific demands, improving cost management, and maintaining high safety standards to enhance the network's overall performance and profitability.

Keywords: *Level of effectivity; operational performance; public transportation; transportation demand management*

1. Introduction

The world has not escaped the challenges of congestion, which have arisen as a result of the influx of vehicles and the subsequent rise in private vehicle ownership. Existing road and traffic management infrastructure, however, could not substantially accommodate the sudden surge in vehicle ownership and traffic congestion. Although traffic congestion is experienced in both developed and developing world countries, studies confirm that it is more prevalent in the developing world (Sustainable Mobility for All, 2017). Congestion in developing nations is additionally linked to restricted road infrastructure and a shortage of resources for traffic management. South East Asia's biggest country, Indonesia, particularly metropolitan areas of Jakarta and Bandung is no exception to this problem. Bandung stands as the second-largest metropolitan area in Indonesia, facing severe congestion issues. The city's congestion problem is exacerbated by a substantial number of motorcycles and a significant population of private cars, which, in turn, has adverse environmental impacts (Farda and Mazzulla, 2018).

Traditionally, the solution to this problem has involved expanding road infrastructure. However, this approach has become less viable due to limited urban space and new complications arising from increased road expansion. On the other hand, the government has provided public transport that people can use

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although, in reality, most people still drive their own vehicles. It impacts to the public transport performance does not afford satisfaction for passengers (Mutiawati et al., 2022).

Transportation Demand Management (TDM) strategies can provide a range of benefits including congestion reduction, cost savings, improved consumer choices, environmental quality, and liveability (Litman, 2003). TDM has the potential to reduce congestion, lower pollution levels, and improve community well-being in developing cities (Zimmerman, Dahdah, and Wang., 2012). TDM measures have shown their potential to deliver numerous benefits, including reduced congestion, lower pollution levels, decreased energy consumption, and overall improved well-being (Leo, Morillón, and Silva, 2017). Transportation Demand Management, or TDM, involves various strategies aimed at modifying travel behaviour to enhance transport efficiency, contributing positively to both economic and environmental goals (Narasimha and Mohle, 2001). A well-structured transport demand management policy not only addresses immediate travel needs but also optimizes long-term utility and system efficiency (Jara-Diaz, 2007). Transport Demand Management serves as a key pillar of sustainable urban transport, enabling more integrated and multi-modal approaches (Black and Schreffler, 2010).

The flexibility of Transportation Demand Management (TDM) allows it to be applied in diverse situations, achieving significant impacts on travel demand and system efficiency (Ferguson, 1990). Various experts and literature have categorized TDM strategies into different groups based on their shared characteristics. According to a study by SIWK in 2007, these TDM strategies can be classified into nine main categories, including managerial and institutional contexts, regulation, information provision, land use strategies, public transportation modes, non-motorized modes, mode substitution, and innovative ideas (Kusumantoro et al., 2009).

One strategy for implementing the TDM approach is to establish an effective public transportation system. A properly functioning public transit system inherently diminishes an individual's inclination to rely on their private vehicle. An illustrative case is the TransMilenio System, which stands as the most substantial investment in public transportation made in Colombia during the last decade. This system has had noteworthy impacts on travel times, transportation costs, environmental concerns, accident rates, and the urban development of the country's capital city. The TransMilenio System has received recognition as a prominent exemplar of sustainable transportation practices (Hidalgo et al., 2013). The effectiveness of public transport is often influenced by external factors such as vehicle ownership rates and the presence of metro systems in a city (Georgiadis, Politis, and Papaioannou., 2020). On-demand services, such as carsharing, can increase operational efficiency within public transport systems (Cuevas, Estrada, and Salanova., 2016).

In this research, we aim to explore the effectivity level of Trans Metro Pasundan as one of TDM Strategy that implemented in Bandung, Indonesia. The main aim of this paper is to explore effectivity of Trans Metro Pasundan by examining fleets number, vehicle utilization, load factor, accident rates; and financial performance, such as revenue per kilometre and cost per kilometre as the measurement dimension. However, the structure of the paper will be: the literature review in Section 2, while the methodology is discussed in Section 3. The findings are discussed in Section 4, and the analysis result is described in Section 5. The conclusions and policy recommendations are presented in the final section.

2. Trans Metro Pasundan

Trans Metro Pasundan is an urban bus transportation system that serves the Greater Bandung metropolitan area in West Java, Indonesia. The operation of Trans Metro Pasundan commenced on December 27th, 2021. Trans Metro Pasundan is the eighth service in the Buy the Service program which provided by the national government. In addition, the idea was initiated by the Ministry of Transportation of the Republic of Indonesia through the Directorate General of Land Transportation that carried out by purchasing services from operators with established minimum service standards.

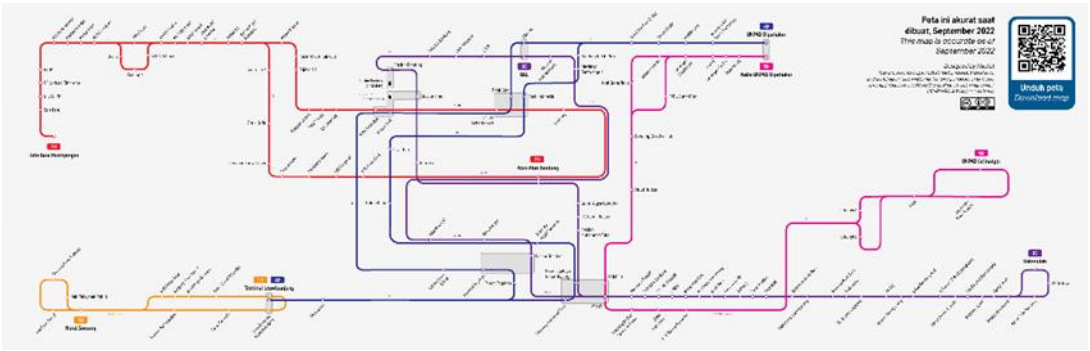

Figure 1. Trans Metro Pasundan Operating Corridors

The Trans Metro Pasundan service consists of five corridors serving the city of Bandung and its surrounding areas. These corridors include Leuwipanjang-Soreang (K1BD), Kotabaru Parahyangan-Alun Alun Kota Bandung (K2BD), Baleendah-Bandung Electronic Center (K3BD), Leuwipanjang-Dipatiukur (K4BD), and Dipatiukur-Jatinangor (K5BD). The operators responsible for the Trans Metro Pasundan service are Perum DAMRI and PT Big Bird Pusaka. PT Big Bird Pusaka manages the Kotabaru Parahyangan-Alun

Alun Kota Bandung (K2BD) and Baleendah-Bandung Electronic Center (K3BD) corridors, while the other corridors are managed by Perum Damri.

3. Methods

The purpose of this study was to explore effectivity level of Trans Metro Pasundan as a public service by measuring its performance and identifying sectors or components that should be improved.

3.1 Research Design

In terms to measure the performance level of the Trans Metro Pasundan (TMP), this can be assessed by Transport Demand Management (TDM) approach. TDM has total nine major classifications; additionally, the study will focus on public transportation mode category as the Trans Metro Pasundan is developed for public services, and this strategy is oriented towards the provision of public transportation. Furthermore, the effectiveness of public transportation has two components, such as cost-effectiveness (refers to inputs and consumed services) and service effectiveness (refers to produced services and consumed services). Similarly, performance can be measured as the evaluation of an organization's performance, such as capital, vehicles, and facilities (Girma, 2023).

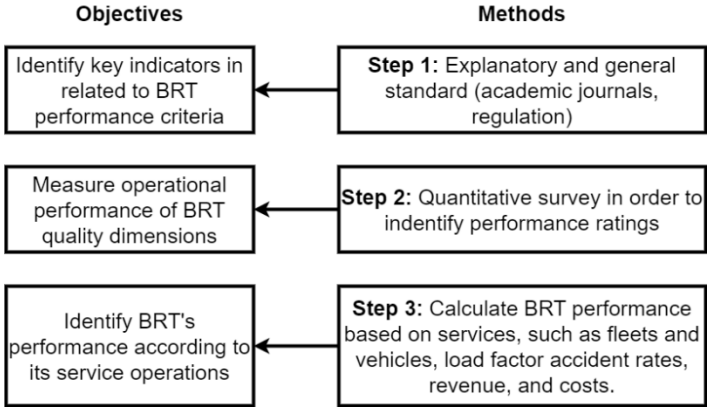

Figure 2. Framework of the research

Effectiveness is generally thought as a reflection of how well a transportation system accomplishes its objectives. Typically, this is associated with the operational and financial performance. Operational performance can be assessed using four indicators are: fleet numbers, vehicle utilization, load factor or passenger services, and accident rates. On the one hand, financial performance can be addressed by revenue-cost ratio. All indicators are necessary to measure the public bus performance.

3.2 Data Collection Methods

To aim its objectives, the assessment was using data from the planning documents of the Trans Metro Pasundan and other supporting academic researches. Furthermore, to collect the data of performance ratings, quantitative surveys was required. The selected indicators used in this study are operational component: fleet number, vehicle utilization, load factor, accident rates; and financial components, including revenue, cost, net-profit margin (Girma 2023; Saleem et al., 2023).

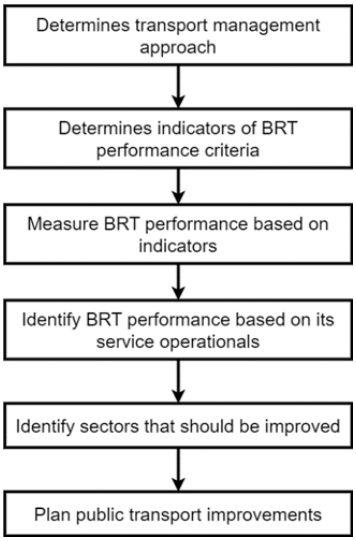

Figure 3. Methodology of the research

3.3 Data Analysis Techniques

This study used measurements in related to operational performance based on selected performance indicators, both operational and financial components. Operational components consist of fleet number, vehicle utilization, load factor, accident rates while the financial components consist revenue per kilometre and cost per kilometre.

3.3.1 Operational Measurements

Operational measurements used the data from fleet number, vehicle utilization, load factor, and accident rates. At first, fleet number refers to the number of buses held by the service provider in terms to deliver users in the city. This component would be assessed through time-series data to figure out the fluctuation of buses amount. In addition, vehicle utilization is determined by the total distance a vehicle travels along a specific route within a day. The optimal use of vehicles occurs when they cover a higher number of meaningful kilometres on the road (Berhan, Beshah, and Kitaw., 2013).

Furthermore, the purpose of load factor is to evaluate the average number of users in a year. Hence, the number of passengers transported by the Trans Metro Pasundan would be calculated per bus per year and per bus per day. This study also measures the accident rates by the Trans Metro Pasundan operational to figure out the operational safety. Accident rates would be calculated the number of accidents per 100.000 km (Eboli and Mazzulla, 2012; Girma, 2023; Wirasinghe et al., 2013).

3.3.2 Financial Measurements

Financial support is on of the important in public transportation as the capital of public buses is from the government alongside with the companies, in Public-Private Partnership schemes. Furthermore, financial components to assess effectivity level of public transportation can be measured by revenue and cost, which is calculate per kilometre. The main reason of the revenue component was to evaluate the fleet utilization of the Trans Metro Pasundan during a given year. It would be measured by traffic-revenue per kilometre and total-revenue per kilometre for each bus line. On the other hand, to evaluate the bus operational profitable, it can calculate cost component through 5-year data to review its trendline. Hence, the cost of transit service providers in the city would be calculated in per kilometre (Katke and Laxman, 2017).

4. Result

4.1 Fleet Number

In examining the operational fleet data for the five routes, it is evident that Dipatiukur - Jatinangor via Toll route operates with the highest number of vehicles, suggesting that it either serves a larger customer base or covers a more extensive area requiring more units in active operation. In contrast, Leuwi Panjang - Dago maintains the smallest operational fleet, hinting at lower demand or a more streamlined operation. The other routes—Leuwi Panjang - Soreang, Baleendah - BEC, and Kota Baru Parahyangan - Alun-Alun Kota Bandung—display moderate fleet sizes that indicate a balanced approach to fleet management, likely reflecting a harmonization of fleet availability with the existing demand levels. The uniformity in the substitution strategy, with each route having precisely two units for substitution, underscores a consistent backup policy across the board, ensuring service continuity. This analysis suggests that while certain routes like Leuwi Panjang - Dago might be operating under capacity or with maximized efficiency, others like Dipatiukur - Jatinangor via Toll have a higher operational threshold, perhaps due to higher demand or geographic coverage. Overall, the fleet management strategy appears to be well-calibrated to the varying demands of each route, with a clear protocol for substitutions, ensuring reliability and readiness to serve the commuting public.

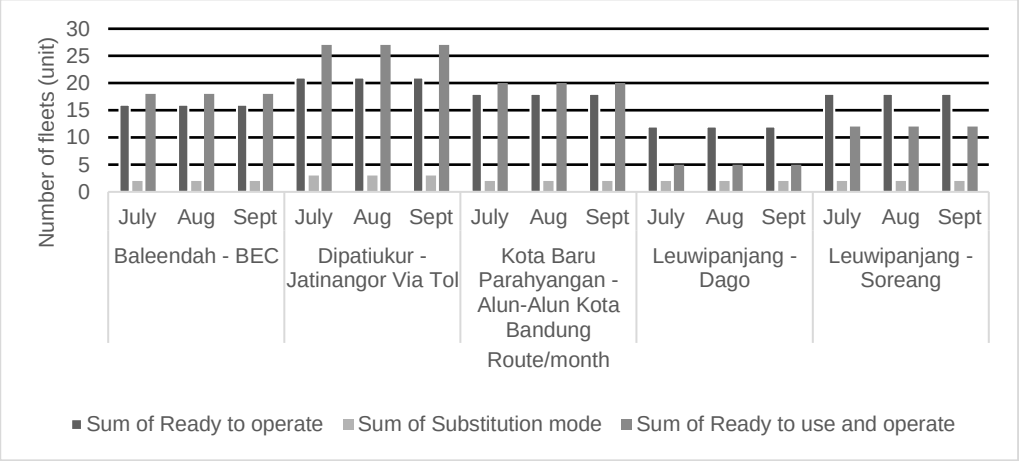

Figure 4. Trans Metro Pasundan Number of Fleets, July to September 2023 (Directorate General of Land Transportation, 2023)

Based on the analysis of the data, it is evident that the fleet operations across the five routes exhibit a high level of consistency and stability. The number of units ready to operate is maintained without significant fluctuations, reflecting a well-managed fleet that meets the demand without requiring large-scale changes or reinforcements. The consistently low numbers in the substitution mode across all routes suggest that the operational vehicles are reliable and do not often need to be replaced with substitutes. Moreover, the total operational fleet numbers, encompassing both ready to operate and substitution units, indicate a sufficient number of vehicles to cover the operational needs. There are no signs of seasonal impact or unusual variations that would suggest external factors affecting fleet management. Overall, the operations are characterized by a smooth, efficient fleet management system that effectively maintains service continuity and operational readiness.

4.2 Vechile Utilization

Upon analyzing data for vehicle productivity across various routes over the months of July, August, and September, several insights emerge. The route between Dipatiukur and Jatinangor via Toll exhibited the highest overall productivity with a total of 660,969.22. This route also maintained the highest productivity each month, showcasing its consistent performance. On the other hand, the route from Leuwipanjang to Dago had the lowest productivity, both in total, amounting to 97,180.58, and monthly across all three months. On average, the Dipatiukur - Jatinangor via Toll route had the highest monthly productivity at 220,323.07, while Leuwipanjang - Dago had the lowest at 32,393.53. The overall trend across all routes was a decrease in productivity from August to September, indicating a potential seasonal pattern or a broader change in operational effectivity or demand.

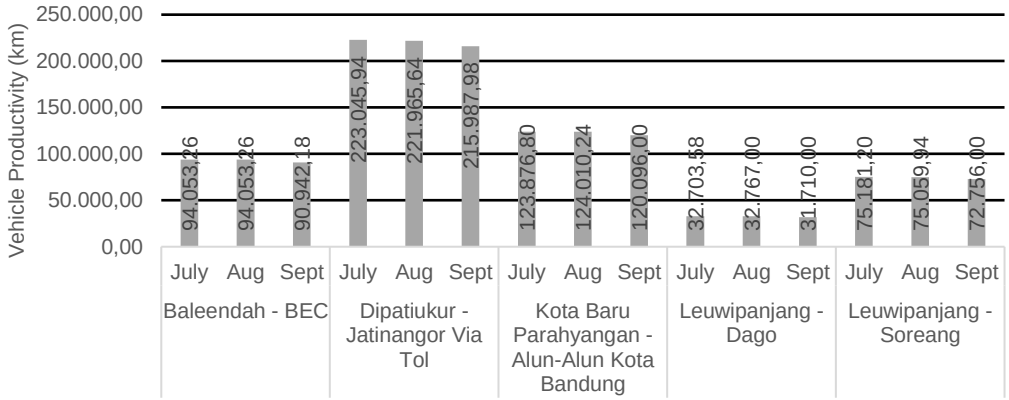

Figure 5. Trans Metro Pasundan Fleet Utilization, July to September 2023 (Directorate General of Land Transportation, 2023)

Analyzing the vehicle productivity data across various routes and timeframes, we can draw several conclusions. The Dipatiukur - Jatinangor via Toll route emerged as the most productive, indicating its significant role in the transport network, likely due to high demand and strategic importance. Notably, while the Baleendah - BEC route showed no change from July to August, a downward trend is observed in September, suggesting external influences impacting productivity towards the end of the period. Furthermore, the fluctuations observed, such as the minor increase in the Kota Baru Parahyangan - Alun-Alun Kota Bandung route from July to August, followed by a subsequent decrease, may be attributed to temporary factors affecting demand. Overall, the data not only identifies the strongest and weakest performing routes but also underscores a general decline in productivity towards the end of the studied period, necessitating a deeper exploration into the underlying causes. These insights are crucial for optimizing route effectivity and strategizing future improvements in the transportation network.

4.3 Load Factor

The analysis of the load factor data across the five routes over three months reveals distinct patterns of fleet utilization, indicating varying levels of demand effectivity. The Kota Baru Parahyangan - Alun-Alun Kota Bandung and Baleendah - BEC routes consistently demonstrate the highest demand, with load factors above 60%, suggesting robust utilization of resources. On the other hand, the Leuwi Panjang - Dago route struggles with the lowest load factor, remaining around 20%, which may indicate an overcapacity issue or insufficient demand. The Dipatiukur - Jatinangor via Toll route exhibits a notable increasing trend in load factor, pointing towards a growth in demand or improved service utilization over time. Lastly, the Leuwi Panjang - Soreang route maintains a moderate and relatively stable load factor, suggesting steady demand. In conclusion, while some routes show healthy demand, others may benefit from strategic adjustments in fleet management or marketing efforts to enhance effectivity and utilization.

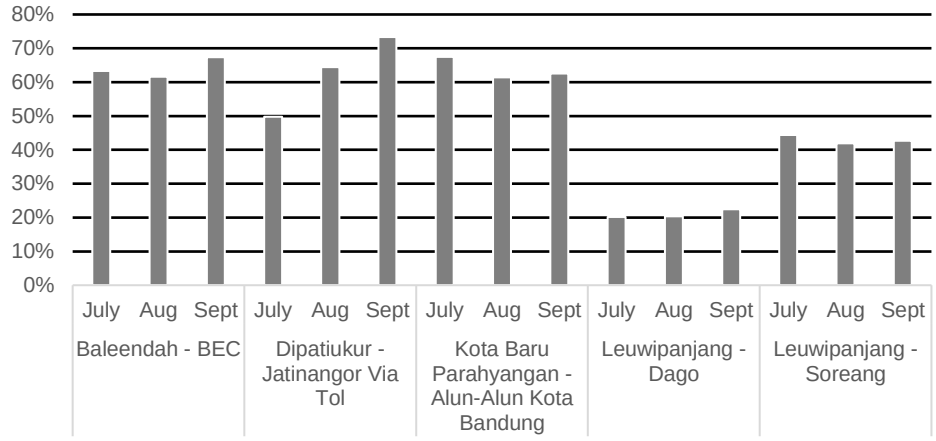

Figure 6. Trans Metro Pasundan Load Factor, July to September 2023
(Directorate General of Land Transportation, 2023)

The data reflects diverse operational conditions across the routes, with some routes showing room for optimization. It is crucial for the transportation service provider to delve into route-specific conditions, customer feedback, and competitive analysis to understand the underlying factors affecting each route's performance. Focusing on the routes with lower load factors could involve tailored marketing campaigns, service adjustments, or alternative scheduling strategies to better match the fleet size with actual demand. Routes with higher load factors might still benefit from fine-tuning to maintain and incrementally improve their effectivity.

4.4 Traffic Revenue

In this study to determine the amount of revenue earned is by multiplying the ticket price by the number of passengers per month, this is done because researchers did not get secondary data on revenue. The revenue analysis across various transport routes over a three-month period reveals distinct patterns indicative of each route's market dynamics and operational success. Baleendah - BEC experienced a revenue peak in August, suggesting a period of high demand or an effective operational strategy, which however was not sustained into September, as indicated by a notable revenue drop.

Dipatiukur - Jatinangor via Toll showed a declining revenue trend each month, starting from the highest revenue point in July and descending to the lowest in September, pointing towards a consistent decrease in ridership or revenue per rider that may necessitate a review of pricing or service quality. In contrast, Kota Baru Parahyangan - Alun-Alun Kota Bandung demonstrated resilience with a rebound in September after a dip in August, hinting at successful corrective measures or seasonal variations in demand. The Leuwi Panjang - Dago route showed a peak in August followed by a decrease in September, a fluctuation that could correspond to external events affecting ridership.

Lastly, the steady month-over-month increase in revenue for the Leuwi Panjang - Soreang route, culminating in the highest revenue in September, indicates growing demand or enhanced route efficiency. This route's consistent upward trajectory contrasts sharply with the other routes, suggesting that whatever strategies or conditions are contributing to this growth could potentially be replicated on other routes to improve their financial performance. Overall, the varying revenue trends call for a nuanced understanding of each route's unique challenges and opportunities to optimize revenue generation.

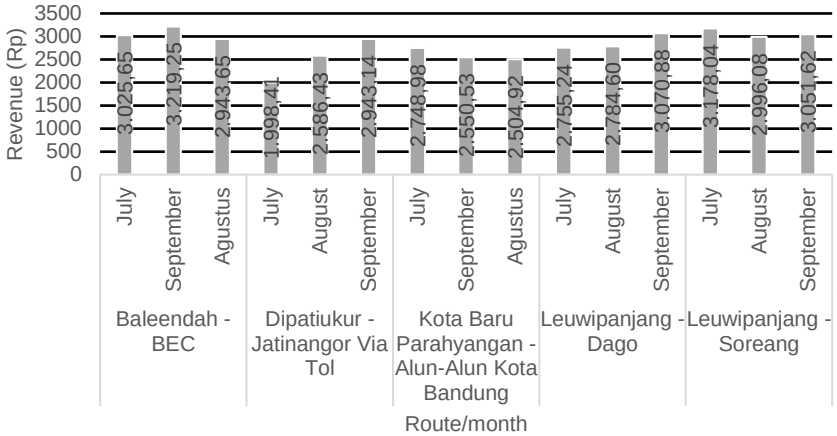

Figure 4. Trans Metro Pasundan Traffic Revenue, July to September 2023
(Directorate General of Land Transportation, 2023)

4.5 Traffic Cost

The breakdown of fuel costs across the transport routes paints a telling picture of operational expenditures. The Dipatiukur - Jatinangor via Toll route stands out with the most significant fuel expenses, totaling Rp 465,385,200.00. This considerable figure suggests a route that either extends over a longer distance, experiences high traffic volume, operates with a greater frequency of trips, or utilizes vehicles with lower fuel efficiency. The stark contrast with Kota Baru Parahyangan - Alun-Alun Kota Bandung, where fuel costs are less than half at Rp 235,074,776.00, hints at a more cost-effective operation possibly due to shorter distances, fewer trips, better traffic conditions, or the use of more fuel-effective vehicles.

The 'Other' category aggregates the remaining routes at a substantially lower expense of Rp 85,238,612.00, indicating that these routes, when combined, incur much lower fuel consumption, perhaps due to shorter distances, lower frequencies, or more effective operations. This discrepancy in fuel costs raises important questions about the profitability and effectivity of these routes, especially when cross-referenced with revenue data. It underscores a potential for optimization, where understanding the nuances of each route's operational characteristics could lead to significant cost savings and improved service profitability. The data suggests that while some routes may benefit from strategic adjustments, others exemplify effective fuel management that could serve as a model for cost reduction initiatives.

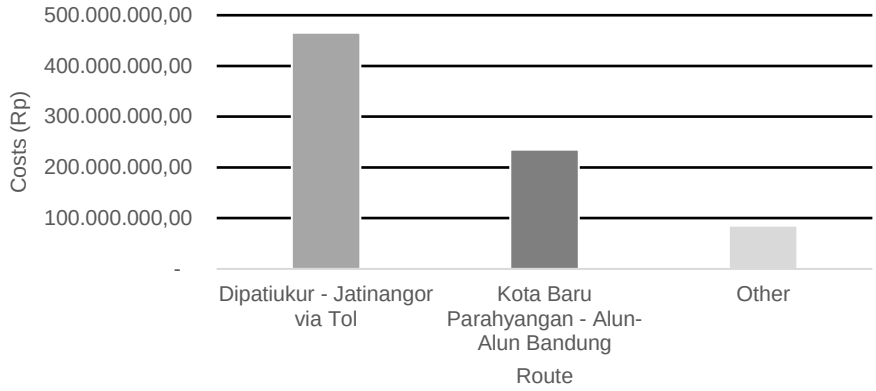

Figure 5. Trans Metro Pasundan Traffic Cost, September 2023
(Directorate General of Land Transportation, 2023)

4.6 Net Profit Margin

Analyzing the provided data, the financial performance of the transport routes varies considerably when juxtaposing traffic revenue against fuel costs. The Dipatiukur - Jatinangor via Toll route has the most substantial annual fuel cost, amounting to Rp 465,385,200.00. Despite showing a progressive increase in monthly revenue, there's a looming concern over whether the revenue growth is sufficient to offset such high fuel costs. Without monthly fuel cost data, precise profitability calculations are elusive, but the upward revenue trend is a positive indicator, although it might not fully mitigate the high fuel expenditures.

Conversely, Kota Baru Parahyangan - Alun-Alun Kota Bandung's route presents a lower annual fuel cost at Rp 235,074,776.00, suggesting more effective fuel usage or a shorter distance. However, the declining revenue from July to September could spell trouble for profitability if this downward trend continues or if the route is subject to seasonal fluctuations in demand. For the routes such as Baleendah - BEC, Leuwi Panjang - Dago, and Leuwi Panjang - Soreang, the absence of specific fuel cost data limits a complete financial assessment. Nonetheless, the stable revenue in Baleendah - BEC and the increasing revenue in Leuwi Panjang - Dago across the three months are encouraging signs, potentially pointing to a healthy profit margin if their fuel costs are aligned with the other routes. Particularly notable is Leuwi Panjang - Soreang, which reports the highest revenue figures in July and September, suggesting it could be the most profitable if its operational costs are on par with or lower than similar routes.

In essence, while the revenues give an indication of the routes' earning capacity, the lack of detailed fuel costs for each month leaves room for speculation regarding their net profitability. A comprehensive financial picture would require a month-by-month breakdown of fuel costs and an understanding of additional operational expenses that impact the bottom line. External factors such as seasonality, pricing strategies, and route efficiency enhancements also play a crucial role in shaping the profitability landscape of these transport services.

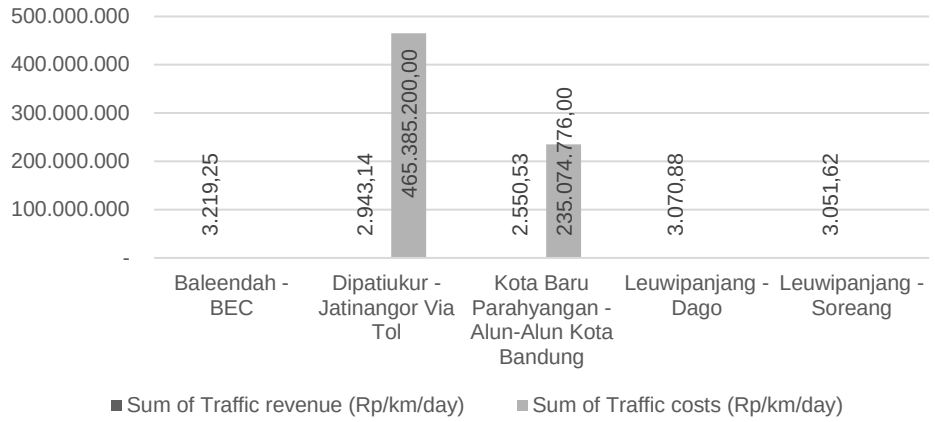

Figure 6. Trans Metro Pasundan Net Profit Margin, July to September 2023 (Directorate General of Land Transportation, 2023)

4.7 Accident Rates

Over the past three months, between August and September 2023, there was a single reported accident involving a Trans Metro Pasundan bus on the Leuwipanjang-Dipatiukur route. The incident tragically resulted in the death of a pedestrian after being struck by the bus. However, it was determined that the cause of the accident was the pedestrian's negligence rather than any error on the part of the Trans Metro Pasundan bus driver or unexpected issues with the bus's performance.

5. Conclusion

After a thorough review of the provided operational data for the transportation service across five distinct routes, it is evident that the fleet number, vehicle utilization, load factor, revenue, costs, and safety performance vary significantly between routes, reflecting the unique characteristics and challenges of each.

Dipatiukur - Jatinangor via Toll route operates with the highest number of vehicles, signalling robust demand or a larger service area. This is reinforced by its top productivity figures, yet this route also incurs the highest fuel costs, raising questions about its cost-effectivity despite its apparent popularity. Conversely, Leuwi Panjang - Dago route has the smallest fleet and the lowest productivity, indicating potential overcapacity or a need for improved effectivity in its operations. Kota Baru Parahyangan - Alun-Alun Kota Bandung and Baleendah - BEC routes exhibit strong load factors, suggesting effective utilization of assets in response to demand. This contrasts with Leuwi Panjang - Dago route, which could benefit from a reassessment of its capacity versus demand to enhance its load factor.

Revenue analysis uncovers varied market dynamics; for instance, the declining revenue trend on the Dipatiukur - Jatinangor via Toll route may necessitate a revision of service offerings or pricing strategies, while the increasing revenue on Leuwi Panjang - Soreang route suggests growth opportunities that could be replicated on other routes.

While the overall profitability of the routes cannot be conclusively determined without detailed monthly fuel cost data, Leuwi Panjang - Soreang route's strong revenue performance indicates a potential for higher profitability, assuming its operational costs are controlled effectively. The single accident on Leuwipanjang - Dipatiukur route, attributed to pedestrian negligence, suggests that the service provider maintains a commendable safety record, a critical component of public transport operations.

In summary, while some routes demonstrate healthy demand and effective operations, others highlight areas for optimization and strategic realignment. The varied revenue and cost patterns suggest a need for tailored approaches to pricing, service quality, and operational effectivity. The transportation service provider should continue to focus on understanding route-specific demands, improving cost management, and maintaining high safety standards to enhance the network's overall performance and profitability.

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