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Impact Analysis of Public Transport on Traffic Congestion: Case Study of Jalan Pangeran Muhammad, Majalengka

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ABSTRACT

Majalengka Regency is a Level II area experiencing rapid traffic growth. Impact analysis of public transportation on traffic congestion is needed to maintain the smooth running of existing traffic roads in Majalengka, especially in the Simpeureum area on Jalan Pangeran Muhammad, which is the main route with several schools, including SMPN 1 Cigasong, being one of the areas where traffic congestion occurs in West Java Province. This paper aims to impact analysis of public transportation on traffic congestion and determine what effects of public transportation can cause traffic congestion. Often, drivers of public transportation or for example public transportation that park their cars carelessly when dropping off passengers on the side of the road and do not see the surroundings, blocking other vehicles that want to pass behind them so that traffic jams occur even if only a fraction of a second. This problem has long been a core issue in Indonesia, especially in areas with high public transportation use. As well as analyze related issues in the discussion. The research method was carried out by survey for the research source located in Simpeureum, which is on Jalan Pangeran Muhammad, which will go to Rajagaluh - Cirebon road in January 2025 and for data analysis using quantitative. The results showed that the impact of public transportation on traffic congestion still affects traffic roads by parking their vehicles carelessly when dropping off passengers so that other drivers have to wait. However, the relatively short time significantly affects other drivers' time. This paper concludes that congestion caused by public transportation also significantly impacts other drivers. This usually happens because the high rate of indiscriminate parking when dropping off passengers is due to the lack of supporting facilities such as bus or public transportation stops.

1. Introduction

Traffic congestion has become a routine problem in traffic worldwide, and it is getting bigger and bigger. With the rapid growth of the human population and the movement of people from villages to cities or vice versa to improve living standards, private transportation has increased. In contrast, public transportation, such as public transport, has decreased in transportation and passengers. As a result, traffic congestion is an unavoidable problem that often occurs and can impact daily life, such as road drivers feeling stressed because of wasted time, reduced study time or working hours due to late departure for school or work, and other activities. Recent studies have shown that traffic congestion disrupts daily life and affects health, safety, security, the economy, and the surrounding environment. Traffic congestion has become a significant problem in many cities around the world. It is standard and a major issue for human mobility, and it is still growing in size, scope, and complexity (Gierszewski & Koźlak, 2019). Traffic congestion is often heard about in national issues, such as in various countries, for example, Indonesia. This is because the density in Indonesia is quite large, with a population of 282,447,584 people. One classic problem that arises as a country urbanizes is traffic congestion. As

more and more people pack into urban areas, primarily as urban sprawl generates large commuter zones around urban cores, road usage often outstrips capacity (Savirani & Aspinall, 2024). With a vast population, it is unsurprising that public and private transportation levels are also significant. The increase in vehicle volume will result in smaller road capacity if an increase does not match the road network and capacity. If the increasing vehicle volume does not counter the improved network and road capacity, the road capacity decreases. Congestion is also caused by people's awareness of the need to use public transit, which is becoming increasingly common (Suryani, Hendrawan, Adipraja, Wibisono, & Dewi, 2019).

Regional transportation is a tool for travelling to various places with a destination to be addressed. Public Transportation is an essential means of development for life. The increasing population and residential development in big cities show how vital transportation is (Wijayanto, 2019). In addition, there are various types of transportation, such as air, land, and water. The type of public transportation that people use is called public transportation. This type of transportation is very diverse in Indonesia and now even includes online transportation. (Putra, Aufaa, Luthfiyaa, & Sahara, 2023). In certain areas, many residents or communities also have problems, such as no public transportation due to limitations or the area not reaching their location. Due to cities' growing populations, travel demand is significant. Unfortunately, this demand creates several challenges and issues, such as congestion, energy, environmental effects, safety, and security, because urban transport networks are restricted in capacity (Zhong, He, Chow, & Knoop, 2022).

In local areas, people are constantly disturbed by negative things such as traffic violations, indiscriminate parking, and vehicle horn noise when taking their children to school. Congestion, noise, and pollution are among the things that are disliked by all living beings on this earth. This is not only a problem in Jakarta but also in other big cities, even in world cities. (Rohman, 2019). In its development in local areas, whether economic or other, it must use transportation. With the rapid growth of an area, infrastructure, availability of facilities and infrastructure, and public behaviour related to transportation, transportation problems often arise. The number of vehicles crossing the roads in cities causes transportation problems (Mu'allimah & Mashpufah, 2021). The local area has a lot of traffic, and the solution is to use public transportation. As the administrative and metropolitan hub of the DKI Jakarta Province, Central Jakarta is characterized by a high level of activity and a strong demand for mobility, leading to traffic and significant air pollution. One of the initiatives taken by the government to address those issues is the integration of public transportation modes (Tilasman, 2022). Also, infrastructure development can improve public transportation. The findings demonstrate that, first, the development of smart cities has greatly decreased the level of urban traffic congestion and enhanced the calibre and functionality of public transportation (Guo, Tang, & Guo, 2020). And public transportation is also needed in daily life. Public transportation is a necessity and an essential part of overall urban development. Due to its extensive capacity, public transportation is essential in promoting community mobility and reducing traffic congestion (Awahah, Widodo, & Radjikan, 2024).

Public transportation also impacts traffic roads for motorists whose lack of awareness in driving can lead to congestion. Traffic congestion, the environment, society, safety, and land usage are just a few ways public transportation (PT) affects the urban road system. Although PT's benefits are the subject of several studies, little attention has been paid to the effects of PT on congestion, which is a crucial part of any examination of transport performance (Nguyen-Phuoc, Young, Currie, & De Gruyter, 2020). The purpose of writing this journal is to understand what impacts of public transportation can cause traffic congestion and what solutions can be implemented in the context of the times. The problem of traffic road congestion will be discussed in this paper. It also analyzes existing issues, such as international issues, national issues, regional issues, and local issues, to understand what they are and their impact on the environment. This research can also help find

solutions and suggestions related to this paper. It is anticipated that this will aid in understanding issues related to the effect of public transportation on traffic congestion. Based on this information, this journal is entitled "Impact Analysis of Public Transportation on Traffic Congestion: Case Study of Jalan Pangeran Muhammad, Majalengka ".

2. Literature Review

2.1 Public Transportation

For more than 50 years, transportation economics has addressed traffic congestion in great detail (Cheng, Pang, & Pavlou, 2020). Public transportation was first invented in France in 1662. The first bus, called Omnibus, was created. It is a large carriage with a capacity of 8 people, pulled by four horses, and has a fixed schedule, route, and price. And continues to develop at this time. People and things can be moved from one location to another using public transit. Helping individuals or groups get where they're going or transporting items from their starting point to their final destination is the aim (Victory, Rifai, & Handayani, 2022). Public transportation is a tool used to help us travel from one place to another.

Public transportation is essential to a city's economic development because it encourages investment, disperses goods and services, and boosts people's mobility. One of the cities in Indonesia with the best public transportation networks is Jakarta (Putri, 2022). Public transportation can also affect the economy and turn into goods or services. And plays an essential role in encouraging investment. The poor use of public transportation is impacted by this discrepancy, even if half of the metropolitan population prefers to use private vehicles for daily transit. However, exceptional public transportation service might increase the number of passengers (Dermawan, Rifai, Ramadhan, & Isradi, 2021). At this point, public transportation services must be improved so that people will want to use public transportation services because many use private vehicles rather than public transportation services.

Regarding local economic activity, transportation is a secondary or subsidiary demand. Additionally, one of the factors influencing the economy's wheels is transportation (Purwasih, Sidabutar, Suciati, & Fauzan, 2023). For instance, people without private transportation must use public transportation. It is also better to use public transportation than private transportation because it can reduce traffic congestion. In practically every province in Indonesia, buses are used for transportation. For example, in the city of Semarang, there are numerous forms of mass transit, such as buses or public transportation. As part of attempts to solve the problem of traffic congestion, the Central Government, through the Department of Transport, has proposed a Bus Rapid Transit (BRT) scheme (Dewantoro, Rifai, & Akhir, 2022). We often see public transportation along the road when we travel because almost all regions or cities in Indonesia have public transportation. People and things can be moved from one location to another using public transit. Helping individuals or organizations get where they're going or transporting items from their starting point to their final destination is the aim (Rifai, Putra, Isradi, Mufhidin, & Prasetijo, 2022). Public transportation can carry more people than private vehicles.

When travelling from one place to another, it is better to use public transportation to reduce air pollution. One key tactic for enhancing the air quality in cities is to encourage the growth of public transportation. One significant endeavour in developing public transportation in China is the "Transit Metropolitan City" pilot project policy (Kosmidis & Müller-Eie, 2023). Walking and bicycling are not practical choices for many regional excursions. Therefore, public transportation is frequently the sole option for people who cannot drive (Hansson, Pettersson, Svensson, & Wretstrand, 2019). Many also encourage and promote the use of public transportation.

2.2 Traffic Congestion

Traffic congestion has several factors that can affect it globally and individually. For example, one solution is to use public transportation. Individuals are impacted by traffic congestion as well. Some significant issues brought on by traffic congestion are lost time, particularly during peak hours, emotional stress, and more pollutants contributing to global warming (Akhtar & Moridpou, 2021). When a process pauses, lints, stutters, or is not smooth, it is said to be in congestion. Due to traffic congestion resulting from population density and expansion, cars move relatively slowly (Andika, Rifai, Isradi, & Prasetijo, 2022). So when on the traffic road, vehicles stop suddenly, slowing down. It is called congestion.

Traffic congestion can also cause losses to the economy. To solve this problem, public transportation systems must be built and expanded. An ongoing issue for the sustainability of transportation growth is traffic congestion. In addition to causing air pollution, traffic congestion costs drivers money and creates delays and annoyance (Afrin & Yodo, 2020). High traffic volumes brought on by the mixing of local, regional, and through traffic cause traffic congestion. When traffic congestion is a regular occurrence, it will lead to inefficient use of resources and cause disruptions to activities in the surrounding area (Rifai, Surgiarti, Isradi, & Mufhidin, 2021). Traffic congestion can disrupt the surrounding environment, especially for motorists.

Motorized vehicles can also have an impact on traffic congestion. Because they often overtake other drivers and do not look around, drivers are surprised, which can lead to traffic accidents. Traffic congestion, severe injuries and fatalities from traffic accidents, air and noise pollution, and the overuse of public space to support road and parking infrastructure are only a few of the problems that motor vehicle traffic causes in metropolitan settings. Even while efforts to lessen reliance on cars have been practical (Kuss & Nicholas, 2022). When traffic volume gets close to road capacity, traffic congestion happens. Because of the increased congestion during rush hour, traffic bottlenecks may be highly inefficient (Wincent, Rifai, & Isradi, 2022). Traffic congestion usually occurs at certain hours, such as during rush hour.

For all solutions, we can analyze and create protocols for drivers to avoid and reduce traffic congestion. Transportation congestion is one of the main factors affecting the sustainable growth of urban transportation. It's crucial to evaluate present traffic patterns and forecast future ones in order to prevent traffic congestion (Almatar, 2023).

2.3 Public Transportation System

A public transportation system is a public transportation service for passengers, and there is a fee for the service. Accessibility is among the transportation system's most important outcomes. "Door-to-door mobility" could increase the appeal of public transportation, and improving transportation services is an important aspect of social quality (Saif, Zefreh, & Torok, 2019). Terminals for public transportation are also a crucial component of every city since they greatly aid the local populace. A terminal is where people and things enter and exit the transportation system (Rifai, Rafianda, Isradi, & Mufhidin, 2021). Terminals are vital to the public transportation system and the city's residents.

Public transportation systems can also be used for deliveries, such as sending goods to their destination. Public transportation to bring items to intermediate transfer places where they may be delivered by (small) cars to the end customers is one technique to enhance urban delivery operations. We investigate how much distance such a two-tier urban delivery system can save (Azcuy, Agatz, & Giesen, 2021). It is anticipated that when public transportation systems are well integrated, people will abandon private automobiles and make public transportation their first option because it provides a network of connected vehicles that make travel simpler and more seamless (Rifai & Arifin, 2021). In

reality, residents use private vehicles more than public transportation, but at the same time, the public transportation system is trying to get people to use its services.

This system uses an intelligent system that is useful for safety and comfort and can also be an automatic working tool that can make it easier for users. In terms of managing public transportation, security, and other matters, an intelligent transportation system (ITS) is crucial. An essential component of the ITS is the detection of traffic movement. Based on the real-time collection of data on urban road traffic flow, an ITS provides intelligent guidance for reducing environmental pollution and traffic congestion (Chen, Liu, Wan, & Qiao, 2020). Public transportation is one of the basic needs of the urban populace and a crucial part of the city's overall requirements, which is a component of the urban transportation system. Public transportation is essential in supporting urban mobility and makes it convenient for the population to disperse around metropolitan regions and conduct its activities in various locations (Rifai, Lista, Isradi, & Mufhidin, 2021). The urban transportation system plays an essential role in public transportation for the smooth running of urban residents.

The use of IoT can help save labour in the public transportation system. In the use of IoT, there are sensor systems and detection systems related to the public transportation system. Peripheral demographic shifts pressure regional public transportation networks to implement creative solutions. The idea of "smart land" has been raised by the use of Internet of Things (IoT) technologies, which have shown themselves to be a legitimate solution to rural mobility issues (Porru, Misso, Pani, & Repetto, 2020).

3. Methodology

3.1 Objective and Type of Research

The purpose of this study is to determine how public transit affects traffic congestion. The types of research and methods that will be used are quantitative and descriptive research.

3.2 Research Sources and Time

Simpeureum, which is situated on Jalan Pangeran Muhammad, is the research source. It will go to Rajagaluh-Cirebon Road on Monday and Wednesday between 06:00 and 07:00. To be more precise, it is in picture 1 of the research location.

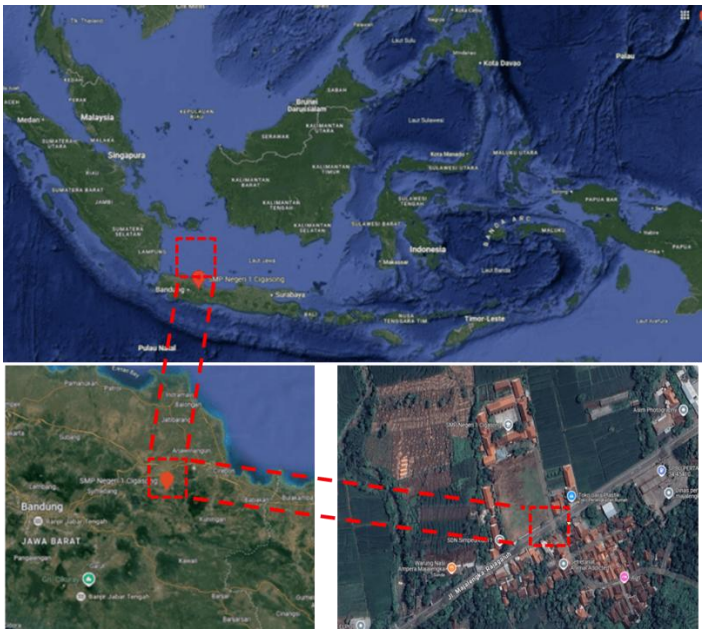

Figure 1. Location
Source: Google Maps

4. Research Data

The table below summarizes the data and information related to the research on the impact of public transport on traffic congestion:

Table 1. Related data and information in the research

No.	Description	Caption
1	Frequency of Public Transportation	Number of public vehicles dropping off passengers at a specific time
2	Headway	The time between public transportation arrivals at a given point
3	Load Factor	The ratio between the number of passengers transported and the capacity of the vehicle
4	Passenger Quantity	Total passengers using public transportation in the survey period
5	Passenger Disembark Time	Average time passengers spend getting off public transportation
6	Congestion Intensity	A measure of traffic density that can be measured through passing vehicles

5. Result and Discussion

From the method used, the results of research data on the impact of public transportation on traffic congestion on Jalan Pangeran Muhammad near SMPN 1 CIGASONG and SDN Simpeureum 1. This road is one of the routes to the city centre, which is heavily traversed by motorbikes, cars, and public transportation. The survey time is adjusted to the school entrance schedule, which is from 06:00-07:00. Table 2 below displays the data results from the field research survey.

Table 2. Research results on the impact of public transportation on traffic congestion

Day	Time	Frequency of Public Transportation	Headway (minute)	Load Factor (%)	Passenger Quantity	Passenger Disembark Time (second)	Congestion Intensity
Monday, 06 January 2025	06:00 - 07:00	30 vehicles	3	700	105	29	3.306
Tuesday, 07 January 2025	06:00 - 07:00	27 vehicles	5	613	92	39	2.932
Wednesday, 08 January 2025	06:00 - 07:00	25 vehicles	4	580	87	32	2.793
Average		27 vehicles	4	631	95	33	3.010
Total		82 vehicles	12	1.893	284	100	9.031

Caption:

Frequency of Public Transportation = Number of public vehicles dropping off passengers at a specific time.

Headway = The time between public transportation arrivals at a given point.

Load Factor = The ratio between the number of passengers transported and the vehicle's capacity.

Passenger Quantity = Total passengers using public transportation in the survey period.
Passenger Disembark Time = Average time passengers spend getting off public transportation.
Congestion Intensity = A measure of traffic density that can be measured through passing vehicles.

During the survey, public transportation drivers often parked their vehicles carelessly when dropping off passengers, causing drivers behind them to be blocked and traffic jams to occur. For more details, see picture 2.

Picture 2. An image of public transportation blocking another vehicle

Based on the full calculation table, the impact of public transportation on the number of passengers from Monday to Wednesday shows significant variation. The number of passengers disembarking ranged from 87 to 105 passengers, with a total of 284 passengers. The average number of passengers per day was about 95 passengers. The frequency of public transportation during this period ranged from 25 to 30 vehicles, with an average frequency of 27 vehicles per hour. In addition, the headway or time between vehicle arrivals was 3 to 5 minutes, with an average headway of 4 minutes. The calculated load factor indicates the efficient use of public transportation capacity, which ranges from 580% to 700%, with an average load factor reaching 631%. Disembarkation times varied from 29 to 39 seconds, with an average disembarkation time of 33 seconds. Overall, this data illustrates that public transportation plays an essential role in community mobility, although some individuals obstruct activities on the public transport system. From the field survey results, there is a lack of legal awareness among drivers, especially public transportation drivers, such as public transportation that drop off passengers carelessly to obstruct other drivers who want to pass.

6. Conclusion

The study's findings demonstrate that the influence of public transportation on traffic congestion on Monday to Wednesday with the exact hour time of 06:00-07:00 still affects traffic

roads by parking their vehicles carelessly when dropping off passengers so that other drivers wait up to 29-39 seconds. However, the time is relatively short, and it dramatically affects other drivers. In addition, the average time when dropping off passengers from public transportation is 33 seconds. The cause of the high traffic congestion on roads, especially on roads close to schools, whether it is junior high school or elementary school, is the lack of supporting facilities such as bus stops or transportation stops.

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