

Examining The Effectiveness of Public Transportation Usage and Its Impacts on Road Congestion in Kuala Lumpur

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ABSTRACT

This study examines the effectiveness of public transportation usage and its impact on road congestion in Kuala Lumpur, Malaysia. The research was conducted in response to persistent traffic congestion in the city and the continued reliance on private vehicles despite substantial investment in public transportation infrastructure. The study pursued four objectives: (1) to identify the level of road congestion in Kuala Lumpur; (2) to examine the relationship between the effectiveness of public transportation usage measured in accessibility, punctuality, quality, infrastructure, time consumption, cost, and environmental on road congestion in Kuala Lumpur; (3) to determine the most contributing factors on the road congestion in Kuala Lumpur; and (4) to investigate the challenges faced by the public regarding the use of public transportation. A mixed-methods research design was collected through a questionnaire distributed to public transportation users in Kuala Lumpur, particularly around Kuala Lumpur Sentral, while qualitative insights were obtained from transportation authorities and relevant literature studies. The quantitative data were analysed using descriptive statistics, Pearson Correlation analysis, and Multiple Regression analysis. The findings indicate that Kuala Lumpur experiences a high level of road congestion. Accessibility, punctuality, quality of service, and infrastructure were found to have a significant relationship with road congestion, with accessibility and infrastructure emerging as the strongest contributing factors influencing public transportation usage. Time consumption and cost efficiency also affected commuters' willingness to shift from private vehicles to public transportation. In addition, respondents identified inadequate connectivity, unreliable feeder bus services, insufficient parking facilities, and long travel times as major challenges in using public transportation. In conclusion, enhancing the accessibility, reliability, quality, and integration of public transportation can encourage a modal shift from private vehicles to public transit, thereby reducing road congestion and supporting more sustainable urban mobility in Kuala Lumpur.

Keywords: Public transportation effectiveness, Road congestion, Kuala Lumpur, Urban mobility, Sustainable transportation.

INTRODUCTION

Overview of Public Transportation in Malaysia

Public transportation in Malaysia has undergone significant development, particularly in urban centres like Kuala Lumpur and Penang. The system encompasses various modes, including light rapid transit (LRT), mass rapid transit (MRT), monorail, bus services, and bus rapid transit (BRT), primarily operated by Rapid KL, a subsidiary of Prasarana Malaysia (Jilani et al., 2023). The rail network facilitates efficient urban mobility, featuring the

Kelana Jaya Line, the Ampang/Sri Petaling Line, and the Kajang Line. However, according to Ong (2022), despite the advancements in public transportation systems in Malaysia, challenges persist, including service quality and integration issues, leading to a preference for private vehicles among Malaysians. That being so, Ong (2022) has highlighted the need for improvements in service quality to enhance customer satisfaction and increase public transport usage. On top of that, restructuring Kuala Lumpur's public transportation system became necessary when initial ridership was lower than anticipated, causing financial difficulties for operators. The financial crisis of 1997 and 1998 exacerbated the situation, leading to the government's intervention through the Corporate Debt Restructuring Committee (CDRC) in November 2001 (Prasarana Malaysia, 2025).

Despite the challenges, the Malaysian government has restructured the public transportation system by separating ownership and operational aspects to address the financial crisis. Prasarana Malaysia was incorporated to facilitate infrastructure projects, taking over assets and operations of existing LRT lines and bus services in 1998 (Rahman & Abdullah, 2016). Another effort to address the poor public transportation usage in Malaysia, the MRT3 Circle Line project intends to enhance access to the underprivileged communities surrounding Kuala Lumpur. It is anticipated to be completed by 2030. However, Yeo (2022) argues that until this system is finished, traffic will probably remain congested since more people will be travelling for business and pleasure, especially in light of the recent reopening of international borders and the rise in post-pandemic economic activity.

Despite these efforts, public transportation in Malaysia continues to face challenges (Borhan et al., 2014). A study by Borhan et al. (2014) focusing on Putrajaya revealed that the existing public transportation system lacks quality and availability, resulting in longer travel times. Hence, to ensure the successful implementation of public transportation, factors such as increasing the number of buses to improve frequency and reduce travel time should be considered. This has proven the importance of public transportation in Malaysia. Public transportation plays a crucial role in Kuala Lumpur's urban landscape, offering a viable alternative to private vehicle use and addressing challenges such as traffic congestion and environmental concerns.

Another study by Mohd Zahari et al. (2024) highlighted that the absence of limitations on private vehicle use makes public transportation a secondary choice for commuting to work. This underscores the need for policies encouraging public transport usage to mitigate traffic congestion and its associated challenges. Furthermore, enhancing public transportation services' safety, security, reliability, and punctuality is essential to attract more users. Addressing these service quality issues can improve public perception and increase the adoption of public transport in Kuala Lumpur (Anuar et al., 2023). However, looking at the performance of public transportation services in Kuala Lumpur today, Kuala Lumpur has made significant strides in enhancing its public transportation system, aiming to alleviate traffic congestion and promote sustainable urban mobility.

The study by United Nations Habitat (2024) assessing urban metabolism and transportation in Kuala Lumpur found that carbon dioxide emissions from major roads, such as Bukit Bintang and Tunku Abdul Rahman, significantly contribute to the city's greenhouse gas emissions. This underscores the need for continued efforts to reduce emissions from the transport sector. Additionally, the poor implementation of bus lanes has been identified as contributing to traffic congestion. According to Liew (2024), despite the existence of bus lanes in theory, their ineffective enforcement allows cars to encroach upon these lanes, reducing the efficiency of bus services and encouraging more people to use private cars.

Furthermore, based on a study by Mustapha (2024), the lack of integration between various modes of public transport leads to inefficiencies and longer travel times. Mustapha (2024) further stated that without a seamless connection between buses, trains, and other transit services, users are discouraged from using public transport, opting for private vehicles, and increasing road congestion. Consequently, Albalade and Fageda (2019) also supported the idea that this imbalance is evident in Kuala Lumpur, where growing car ownership and urban development continue to erode the potential returns on investments made in public transportation. This has demonstrated the ineffective public transportation systems in Kuala Lumpur.

Problem Statement

According to Lim (2024), Kuala Lumpur's road congestion remains a pressing issue, with approximately 1.3 to 1.5 million vehicles entering the city daily. This influx leads to significant delays, especially during peak hours.

In 2022, the TomTom Traffic Index reported that drivers in Kuala Lumpur spent 159 hours on the road during rush-hour traffic, with 75 hours attributed to congestion. This resulted in an estimated additional fuel cost of RM221 per driver and an extra 180 kg of CO₂ emissions per vehicle. If that is not enough, Teh (2022) stated that road congestion in Malaysia was notably worse in Kuala Lumpur, and it is said that the typical travel time to work has become more worryingly longer than what most traffic users could recall from before the Covid-19 pandemic. In fact, according to Hazlin and Wu (2023), some road users in Kuala Lumpur also stated that the traffic jams did not only happen during peak hours but could last for the whole day.

Additionally, Loh and Malik (2022) stated that traffic congestion has worsened due to public concerns over COVID-19, and a lack of social distancing space led to a shift from public to private transportation, which has continued longer. To make it severe, the swift increase in the population and the increasing percentage of people owning cars have made highways more congested. In contrast, Kuyer (2023) revealed a drop in the demand for public transit as more individuals purchase private vehicles, which increases traffic congestion. The study by Loh and Malik (2022) also showed that, based on the data retrieved from the TomTom Traffic Index in 2022, the average level of congestion in Kuala Lumpur for a week since 14 September that year was worse than the level of congestion back in 2019. Having observed this since 2019, the quantity of newly registered automobiles has increased by one million annually. The Road Transport Department (JPJ) projected 21.7 million registered automobiles to be operated countrywide as of September 2021 (Loh & Malik, 2022).

Furthermore, as highlighted by Bernama (2023), indicated that due to an increase in vehicles, traffic was delayed over a 23.9km stretch of the Kuala Lumpur-Karak highway from KM 74.7 to KM 50.8 in the direction of Kuala Lumpur. Not only that, but the Malaysian Highway Authority (2023) also stated that a similar occurrence happens on highways from the south heading towards Kuala Lumpur. What is more concerning is that the more vehicles on the road, the higher the risks of road crashes, especially during traffic congestion. According to the Malaysian Highway Authority's annual report in 2023, the Kuala Lumpur - Karak Highway (KLK), with 20,444 occurrences, saw the most significant number of accidents reported. Seeing the seriousness of this matter, Chia (2024) on Bernama revealed that experts identify a lack of public transportation usage, inefficient urban planning, and policies promoting private vehicle ownership as key contributors to the city's traffic woes. Specifically, the public land transportation expert Wan Agyl Wan Hassan highlights that land use planning often prioritises economic growth, leading to high-density areas lacking proper public transportation systems.

In addition, Minister Dr Zaliha Mustafa emphasises the importance of public transport usage to alleviate congestion, noting that traffic jams typically occur during peak periods involving users travelling for work and other business. This brings attention to the question of whether public transportation in Kuala Lumpur is adequate or not. According to Natividad (2020), the "first-mile and last-mile" connectivity is the main problem with public transportation for users. Not only that, Tan and Looi (2021) report that Kuala Lumpur public transportation customers are well aware of the feeder bus systems in Malaysia, which are designed to facilitate users' transition from the suburbs to the main stations. However, these systems are infamously unreliable. This is due to the feeder buses' propensity to cause delays in users' journeys by running behind schedule.

Additionally, according to Tan & Looi (2021), one of the reasons Malaysians do not wish to use public transport is the station's infrastructure. In fact, for many years, the main public transportation infrastructure problem has been a shortage of parking spaces. Not only that, Tan and Looi (2021) also mentioned that those who choose to drive their cars to the stations instead of taking public transportation have trouble locating a parking space. Moreover, Reporters F.M.T Media (2023) also noted how time-consuming public transportation is in Malaysia. They added that, compared to taking public transportation, driving your private vehicle is typically less taxing and time-consuming. In fact, according to Nazri et al. (2019), some users have even switched to driving private automobiles to reduce the extra stress that comes with commuting.

Another attribute believed to influence the effectiveness of public transportation is the cost incurred by public transportation users. Thøgersen (2009), as cited in a study conducted by Nur Fazzillah et al. (2022), asserts that rising parking costs significantly impact users' decisions to use public transportation. Another matter to pay attention to is the environmental factors that influence how effective public transportation is and how it affects Kuala Lumpur's road congestion. Research conducted by Hoo et al. (2023) indicated that environmental attitudes

are one of the key variables influencing sustainable consumption. Other than that, according to Kuyer (2023), the challenges faced by Malaysians when using public transport commonly pertain to inadequate infrastructure, lack of proper connectivity, insufficient rail networks, inadequate bus services, and inadequate public perception. Hence, based on the above-mentioned statement, this study aims to examine the effectiveness of public transportation and its impacts on road congestion in Kuala Lumpur.

LITERATURE REVIEW

Road Congestion in Malaysia

Road congestion, as it relates to the efficiency of public transportation, occurs when there is an excessive volume of traffic on the road network, causing a slowdown in vehicle movement and possible disruptions in traffic flow. Teh (2022) found that Kuala Lumpur has terrible traffic congestion, and the average commute to work has reportedly gotten noticeably longer than most drivers could remember from before the pandemic. Furthermore, some Kuala Lumpur road-users reported that certain traffic congestion can persist throughout the day in addition to occurring at peak hours (Hazlin & Wu, 2023). In a different study, Loh and Malik (2022) demonstrated that, according to data again obtained from the TomTom Traffic Index, Kuala Lumpur's average level of traffic congestion during a week starting on September 14, 2022, was worse than it was in 2019. Note that as of 2019, there have been an additional number of newly registered cars. As of September 2021, 21.7 million registered cars were expected to be on the road nationwide, according to the Road Transport Department (JPJ) (Loh & Malik, 2022). Highway congestion has increased due to the population's rapid growth and the rising percentage of car owners. As more people buy private vehicles, there is a decrease in the demand for public transportation, leading to an increase in traffic congestion Kuyer (2023).

In addition, a spokesman for the Malaysian Highway Authority (LLM) reported in November of last year that traffic was delayed over a 23.9 km stretch of the Kuala Lumpur-Karak highway from KM 74.7 to KM 50.8 in the direction of Kuala Lumpur due to an increase in vehicles (Bernama, 2023). Similar things occur on the roadways that lead southward into Kuala Lumpur. What is more worrisome is that there is a direct correlation between the number of vehicles on the road and the likelihood of traffic accidents, particularly during peak hours. An illustration later in the report shows an overview of the three leading causes of accidents, namely people, vehicles, and the environment. In 2021, human factors constituted 78% of the causes of accidents, followed by environmental factors at 15% and vehicle factors at 7%. Therefore, road congestion and the effectiveness of public transportation are related to how the transportation system affects traffic flow overall and how much it contributes to managing and reducing traffic on roads.

Effectiveness of Public Transportation Usage in Malaysia

According to the U.S. Department of Transportation (2020), public transportation's primary objective is to facilitate people's movement within urban areas using group travel technologies. This approach reduces the reliance on private vehicles, alleviates traffic congestion, lowers environmental pollution, and promotes equitable access to mobility. The degree to which a public transit system achieves its objectives and offers the general public convenient, dependable, and effective transportation is known as its effectiveness. It includes a range of elements that influence and enhance the general performance of the public transportation system in a particular area or city (Diana & Daraio, 2014). Furthermore, the infrastructure, time efficiency, accessibility, punctuality, quality of service, affordability, and environmental effects are frequently cited as critical factors influencing public transportation's efficacy. Additionally, surveys, assessments, and performance indicators that gauge the system's influence on mobility, convenience, and general satisfaction are frequently used to gauge its efficacy (Carvalho et al., 2015). A community's general quality of life can be enhanced, sustainable urban development can be encouraged, and traffic congestion can be significantly reduced with the help of an efficient public transportation system.

Accessibility

Accessibility to public transportation is vital for Kuala Lumpur's urban development, as it ensures that residents can efficiently reach employment, education, and essential services. A study by Kamarudin et al. (2023) has

highlighted challenges in this area, particularly for individuals with disabilities. For instance, mobility-challenged travellers, notably wheelchair users, encounter significant difficulties when navigating the public transportation system in Kuala Lumpur, which often lacks adequate facilities to accommodate their needs. Another study by Ramli et al. (2023) focusing on the perspectives of persons with disabilities in Kuala Lumpur revealed that the public transportation system's accessibility and connectivity are insufficient to meet their requirements. The findings suggest a pressing need for improvements to create a more inclusive transit environment that caters to all users, regardless of physical ability. Not only that, but walking accessibility also plays a crucial role in public transport utilisation. Research done by Mohd Din et al. (2009) has shown that the ease with which individuals' ability to walk to transit stations significantly affects their willingness to use public transportation. In fact, in Kuala Lumpur, enhancing pedestrian pathways to transportation stations could encourage more residents to opt for public transport, thereby reducing traffic congestion and promoting sustainable urban mobility.

According to Natividad (2020), the "first-mile and last-mile" connectivity is the main problem with public transportation for users. Additionally, frequent Kuala Lumpur public transportation users felt that the public transportation terminals were inconvenient or readily accessible to their intended audience. According to the Centre of Governance and Political Studies' 2018 report, the Affordability of Homes Surrounding MRT Stations, several MRT stations are situated between affluent neighbourhoods that are only accessible to wealthy foreigners. Despite the primary goal of public transportation, which is to enable those with lower incomes to use the resources provided by the government for travel, it has unquestionably been undermined by this. Therefore, improving the accessibility of Kuala Lumpur's public transportation system, particularly for persons with disabilities and pedestrians, is essential since addressing these challenges increases public transport usage, reduces traffic congestion, and creates a more inclusive urban environment.

Punctuality

Punctuality is a critical factor influencing public transportation usage in Kuala Lumpur. A study by Anuar et al. (2023) examining service quality issues in the city's public transport system identified punctuality, safety, security, and reliability as key determinants of user satisfaction. The findings suggest that improving punctuality could enhance overall service quality, thereby increasing public transport utilisation. A 2023 poll revealed that 54% of public transport users in Malaysia cited lack of punctuality as their primary complaint, underscoring its significance in user experience (FMT Media, 2023). This dissatisfaction may deter potential users, increasing reliance on private vehicles and exacerbating traffic congestion. Furthermore, research by Ambak et al. (2012) on passengers' perceived satisfaction with Kuala Lumpur's monorail service indicates that punctuality significantly impacts user satisfaction. It is proven that delays and inconsistent schedules can diminish trust among public transportation users in the system and discourage regular use.

In addition, Tan and Looi (2021) report that Kuala Lumpur public transportation customers are well aware of the feeder bus systems in Malaysia, which are designed to facilitate users' transition from the suburbs to the main stations. However, these systems are infamously unreliable. Furthermore, Kuala Lumpur public transportation users find it extremely difficult to plan their trips when utilising public transportation because feeder buses arrive and depart often and at unpredictable times (Natividad, 2020). As a result, many users give up on the concept of taking public transit and instead choose to drive their private cars, which may exacerbate the local traffic problem. Therefore, Ibrahim et al. (2022) suggested that enhancing the punctuality of Kuala Lumpur's public transportation is essential for improving user satisfaction and increasing ridership. Addressing punctuality issues can lead to a more reliable and efficient public transport system, encouraging greater public adoption and reducing traffic congestion in the city.

Quality

According to a research report by Hoo et al. (2023), which was adopted and altered in this research, the quality of public transportation is one of the variables that influences people's happiness in using it after their first experience. Based on the study by Hoo et al. (2023), only passengers who are pleased with the standard of public transportation are likely to use it again, as opposed to those who were unhappy with the services they received.

The amenities at the station, the ticketing mechanisms, and the staff's attention to cleanliness and comfort in the public transit system are all examples of services that influenced the effectiveness of public transportation usage. Furthermore, Ubaidillah et al. (2022) supported this by stating that the quality of public transportation services in Kuala Lumpur significantly influences user satisfaction and ridership levels. Based on a study result conducted by Ubaidillah et al. (2022), tangibility, which encompasses the physical aspects of service, such as vehicle condition and cleanliness, is considered the most influential among the key service qualities identified.

In the context of Kuala Lumpur's monorail services, research by Ibrahim et al. (2022) indicates that service quality directly impacts passengers' perceived satisfaction. In addition, a study by Onn et al. (2014) focusing on MyRapid, a significant public transport provider in Kuala Lumpur, highlights that dimensions like reliability, assurance, and responsiveness are essential in determining customer satisfaction. Based on the findings, it is proven that enhancing the quality aspects of public transportation can increase users' preferences for public transportation, thereby contributing to reduced traffic congestion and environmental benefits. Therefore, improving the quality of public transportation services in Kuala Lumpur is vital for enhancing user satisfaction and encouraging higher ridership (Ngah et al., 2020). Shamsudin (2020) also agreed that focusing on key service quality dimensions can lead to a more efficient and user-friendly public transport system, promoting sustainable urban mobility.

Infrastructure

A well-developed transit infrastructure facilitates seamless connectivity, reduces traffic congestion, and promotes sustainable urban development. According to Tan & Looi (2021), one of the many reasons why Malaysians do not wish to use public transit is due to the public transportation station's infrastructure. For many years, the main problem of public transportation infrastructure has been a shortage of parking spaces. Not only that, Tan and Looi (2021) also noted in their article that those who drive their cars to the stations instead of taking public transportation have trouble locating a parking space. Additionally, a study by Ho et al. (2017) stated that there were more cars than parking spaces allotted at the parking bays, which may have contributed to the aggressive parking pattern at the car park. Hence, the infrastructure of public transportation in Kuala Lumpur is a challenge for users when travelling around the city.

A study by Rahman et al. (2018) has highlighted issues such as inadequate integration between different transit modes and the need for improved facilities to accommodate all users, including those with disabilities. Thus, addressing these challenges and the lack of proper infrastructure is essential to ensure that the infrastructure meets the population's diverse needs. Furthermore, Irtema et al. (2018) also believed that the design and planning of transit infrastructure significantly impact user satisfaction and ridership levels. In addition, research conducted by Barter (2004) also indicates that factors such as station accessibility, availability of amenities, and the overall condition of facilities play a crucial role in shaping public perception and utilisation of public transport services. Consequently, the public transportation infrastructure in Kuala Lumpur is a critical component of the city's urban framework. Continuous improvements and strategic planning are necessary to address existing challenges and to create a more efficient, accessible, and user-friendly public transport system that meets the evolving needs of its residents.

Time Consumption

The users prioritise modes of transport that minimise travel time, influencing their daily choices between public transit and private vehicles. Tan and Looi (2021) stated how time-consuming public transportation is in Malaysia. Not only that, but Nazri et al. (2019) also added that compared to taking public transit, driving your private vehicle is typically less taxing and time-consuming. This is because travelling by bus or rail can often take much longer than travelling by car because these modes of transportation require numerous stops before arriving at their destination. Consequently, the long travel times discourage users from using public transportation. Some clients have switched to driving private automobiles to reduce the extra stress that comes with commuting. Furthermore, a study by Majid et al. (2020) examining the impact of time attributes on Mass Rapid Transit (MRT) ridership in Kuala Lumpur found that travel time significantly affects the users' decisions to use public transport.

The research suggests that reducing travel times through efficient scheduling and minimising delays can enhance the attractiveness of MRT services, thereby increasing ridership.

Additionally, the reliability of travel time is crucial. Specifically, unpredictable delays can deter potential users from opting for public transportation. To support this statement, research done by Mohamed et al. (2021) on bus travel time reliability indicates that factors such as traffic congestion, number of stops, and passenger boarding times influence overall travel time consistency. Therefore, Moosavi et al. (2023) suggest that minimising travel time and enhancing its reliability are essential for increasing public transportation usage in Kuala Lumpur. Implementing strategies to reduce delays and improve scheduling can make public transit more appealing, encouraging a shift away from private vehicle use and reducing city traffic congestion.

Cost

The cost of public transportation significantly influences users' behaviours in Kuala Lumpur. This is because affordable fares and public transport rebates have been identified as key factors contributing to sustainable transportation costs by research by Nur Fazzillah et al. (2022). Besides, a study conducted by Majid et al. (2022) on public travellers in the Klang Valley found that a monthly transportation cost of RM400 was considered sustainable, primarily due to affordable fares and public transport rebates. Additionally, the affordability of public transportation is crucial in promoting its use over private vehicles. Research by Onn et al. (2014) indicates that the high cost of private car ownership and maintenance often leads individuals to consider public transport a more economical alternative. In contrast, research by Jilani et al. (2023) found that the residents in Kuala Lumpur are discouraged from using public transport because of rising pass prices and unreliable service. For public transportation users with middle-class and lower-class incomes, public transportation is less competitive than private vehicles due to high costs and subpar service quality.

Further, Thøgersen (2009), cited by Nur Fazzillah et al. (2022), asserts that rising parking costs significantly impact people's decisions to take public transportation. This is further corroborated by a different study that claims that policies in Malaysia related to public transportation frequently centre on the expenses and pricing of the system (Azari et al., 2013), especially the cost of parking spaces (Van Malderen et al., 2012). Also, Natividad (2020) revealed that Cheong Sze Hoong Zac, a TRANSIT Malaysia member and supporter of public transportation, said he drives his car to rail stations. He then revealed that he either parks near the station or drives and uses an e-hailing service like Grab, which increases the cost of using public transportation because he has to pay for multiple modes of transportation to get to one place and has to worry about fuel when he drives his car. Consequently, one of the key elements influencing Kuala Lumpur residents' utilisation of public transportation is the cost and pricing associated with doing so.

Environment

According to Mukhopadhyay (2017), transportation significantly contributes to greenhouse gas emissions, accounting for an estimated 22.9% of all carbon emissions in Malaysia as of 2015. Besides, the study by Hoo et al. (2023) assumes that environmental factors have a role in the efficacy of public transportation and its influence on traffic congestion in Kuala Lumpur. This is because Hoo et al. (2023) indicated that environmental attitudes are one of the key variables influencing sustainable consumption. Further, a person's views regarding the environment and environmental issues may impact their pro-environmental behaviours. This statement is also supported by a study by Huang et al. (2019) showing a positive correlation between pro-environmental behaviour and attitudes of public transportation users. Additionally, a study by Muhammad et al. (2018) indicates that travellers who practise sustainability report feeling happier. The fact that tourists care about the environment enough to learn about and opt for sustainable modes of transportation is evidence of this.

Not only that, but a study by Shahidan & Shafie (2020) assessing urban metabolism and transportation in Kuala Lumpur found that carbon dioxide emissions from major roads, such as Bukit Bintang and Tunku Abdul Rahman, significantly contribute to the city's greenhouse gas emissions. The research highlighted that transportation is a significant source of carbon dioxide in the city, underscoring the need for sustainable transport solutions. Consequently, in response to these environmental challenges, Kuala Lumpur has initiated projects to reduce

transportation-related emissions (United Nations Habitat, 2024). For instance, the River of Life project is a flagship urban regeneration initiative designed to transform the city's riverfront into a vibrant, eco-friendly destination. This project integrates natural elements into the cityscape and aims to reduce congestion by increasing public transport usage in the neighbourhoods near the river. Therefore, Soo et al. (2018) suggest that addressing the environmental impact of public transportation is essential for Kuala Lumpur's sustainable development. Implementing strategies to reduce emissions from the transport sector can lead to improved air quality, enhanced public health, and a more sustainable urban environment.

Challenges of Using Public Transportation in Malaysia

As of January 2022, several challenges were commonly faced by users using public transportation in Kuala Lumpur, namely, traffic congestion, since Kuala Lumpur is known for its traffic congestion, which affects both private and public transportation. The users may experience delays and longer travel times, particularly during peak hours (Teh, 2022). Secondly, limited coverage is challenged, as some areas in Kuala Lumpur may have limited access to public transportation services, making it inconvenient for residents in specific neighbourhoods (Eboli et al., 2014). This can also lead to the third challenge faced by public transport users, which is the problem with last-mile connectivity. The challenge of reaching the final destination from public transportation stops or stations, particularly for those living or working in areas not well-served by the transit network (Karesdotter et al., 2022).

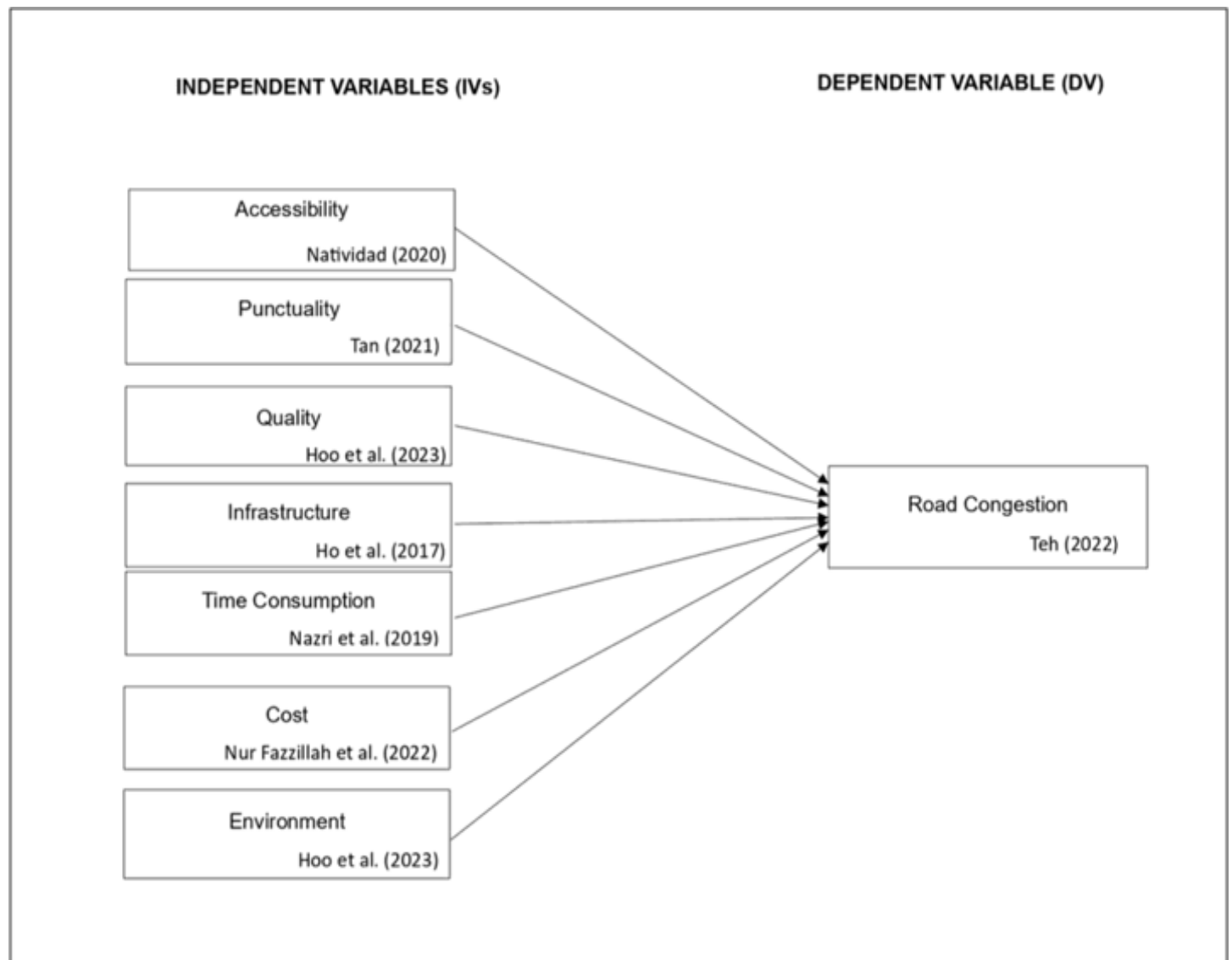
Next, the most common obstacle in using public transportation is the overcrowding problem. Specific public transportation modes, such as buses and trains, may be overcrowded during peak hours, leading to discomfort and inconvenience for passengers (Li & Hensher, 2013). In addition, ticketing system issues include long queues, malfunctioning ticket machines, and difficulties reloading or purchasing tickets (Nur Fazzillah et al., 2022). The public transportation users also stated challenges regarding the service quality, such as safety, comfort and cleanliness concerns, on several occasions. Concerns about personal safety, especially during late hours or in isolated areas around certain public transportation stations, complaints about the cleanliness of public vehicles and stations, and discomfort due to crowded or poorly maintained facilities (Seco & Gonçalves, 2007). Moreover, accessibility issues for individuals with disabilities, including limited facilities such as ramps, elevators, and tactile paving at public transportation stations, cannot be denied since it has happened a few times before (OKU Rights Matters, 2023).

Another common challenge is that punctuality issues, such as delays and irregularities in public transportation schedules, may lead to longer waiting times for users and potential challenges in planning daily activities (Reporters F.M.T, 2023). Last but not least, the affordability of using public transportation also significantly impacts the public since it involves the value of money for them (Aftabuzzaman et al., 2010). Therefore, transportation authorities and policymakers continually work to address these challenges through infrastructure improvements, service expansions, and technology enhancements. Initiatives to improve last-mile connectivity, reduce congestion, and enhance the overall passenger experience are often part of efforts to make public transportation more efficient and attractive in Kuala Lumpur.

Conceptual Framework

According to the literature review, the conceptual framework can be formulated. The conceptual framework proposed a direct relationship between the factors influencing the effectiveness of public transportation, which consists of (i) accessibility, (ii) punctuality, (iii) quality, (iv) infrastructure, (v) time consumption, (vi) cost, and (vii) environment, and its impacts on road congestion in Kuala Lumpur. The moderating variable is included in the framework to see the effects on the strength and direction of the relationship between independent and dependent variables.

Figure 1. Conceptual Framework: Effectiveness of Public Transportation Usage and Its Impacts on Road Congestion in Kuala Lumpur (Source: Author's conceptualisation)



METHODOLOGY

The quantitative method through a cross-sectional study is the research design used to examine the effectiveness of public transportation and its impacts on road congestion in Kuala Lumpur. Moreover, the researcher chose the quantitative method through the cross-sectional study as the research design because it is more affordable and time-efficient than other research designs that fit this research's time frame, since the researcher can gather data at a certain point in time. Additionally, cross-sectional studies enable the researcher to record a particular point in time. For example, national censuses give an overview of the state of the nation at that particular point in time. According to Sekaran & Bougie (2010), the sample size is the number of measurements used to estimate a population's size, including the number of subjects, persons, and items in a subset of a population chosen for examination. The sample will represent the total research population.

Furthermore, the researcher conducted the research in the chosen territory, Kuala Lumpur. This selection is due to the area's critical issue of road congestion, which has been identified in the past few years. Due to this, the population of Kuala Lumpur are required to determine the sample size to be examined in the research. Besides, since the research's focus is to examine the effectiveness of public transportation usage and its impact on road congestion in Kuala Lumpur, the number of people using public transportation in Kuala Lumpur is very important in determining the exact sample size required for the study. Data was provided from Prasarana's Ridership on the monthly ridership of public transportation. The data retrieved is the latest number of public transportation users in August 2024.

Table 1. Population in Kuala Lumpur as of January 2024 (Source: Department of Statistics Malaysia (2024))

Location	Number of Population
Kuala Lumpur	2,067,500

Table 2. Number of Public Transportation Users in Kuala Lumpur as of August 2024 (Source: Prasarana's Ridership (2024))

Location of Public Transportation	Number of Ridership
Kuala Lumpur	35,209,168

Subsequently, a sample size determination calculator was employed to determine the exact sample size used in the research. Given the urgent need for this information, the researcher utilised the Table for Determining Sample Size for a Finite Population by Krejcie and Morgan (1970) to help determine the sample size to be studied (Syed, 2021). As a result, the researcher needs to collect 384 respondents for the sample size (S) since the total population gathered previously has reached the maximum population size (N) stated.

Regarding the sampling technique, the researcher of this study employed the purposive sampling technique to determine a specific segment of the population chosen as the sample. The researcher decided to use this purposive sampling technique to select the study's territory and sample size. Specifically, the researcher used purposive sampling to choose Kuala Lumpur as the geographical location of the study due to the critical issue of road congestion in that area. Besides that, the researcher also uses purposive sampling to select the study's respondents. However, there are three (3) inclusion criteria set by the researcher before selecting the subject of the study. Those inclusion criteria are (i) an individual public that frequently uses public transportation in Kuala Lumpur, (ii) an individual public that had experience using public transportation in Kuala Lumpur, and (iii) an individual who is concerned about the environment-related issues due to transportation and congestion.

For this study, the researcher uses both primary and secondary data. Gathering primary data entails getting original information from the source or speaking with respondents face-to-face (Guide & Duggal, 2023). Using this approach, researchers can get firsthand data well-suited to the research objectives. The research has distributed online questionnaires to the targeted respondents to obtain the primary data. Other than primary data, the researcher also gained knowledge relating to the scope of the study through secondary data collection. The secondary data obtained by the researcher are primarily from published sources like books, academic journals, newspapers, and government reports. Other than that, the researcher also looked for research articles, statistical information, and social surveys on online databases accessible. Government and institutional records and past research studies are the primary sources of secondary data used by the researcher for this study. The data collection phases for this research started with the development of the questionnaire set, followed by the approval of the ethics application; data collection for the pilot study consisted of 30 respondents to ensure the reliability and normality of the questions set after obtaining the result of reliability and normality test and ensuring that all the questions are reliable and valid, the actual data collection is done for 3 consecutive weeks at the Kuala Lumpur Sentral Stations. Once the required sample size data were collected, the researcher proceeded to the data analysis processes to obtain the study results.

Since the researcher wants to examine the effectiveness of public transportation and its impacts on road congestion in Kuala Lumpur, the Statistical Package for Social Science (SPSS) software applications were used to analyse the data for this study. The researcher used descriptive analysis to examine for any data entry errors in the system. Additionally, the researcher will describe the data using the means, median, mode and standard deviations as the measures of central tendency. One can determine the mean or average by adding up each figure in the data set and dividing the result by the total number of figures in the collection. Hayes et al. (2023) explained the mean by showing an example of the following data set with a sum of 20: (2, 3, 4, 5, 6). Four is the mean (20/5). The value that appears the most frequently in a data collection is its mode, and the figure in the middle is

its median. In a data set, the figure divides the upper figures from the lower figures. Furthermore, in examining the effectiveness of public transportation and its impacts on road congestion in Kuala Lumpur, the first research objective is to identify the level of road congestion in Kuala Lumpur using descriptive analysis. This helped the researcher identify the level of road congestion in Kuala Lumpur. Besides, the final research objective is to investigate the challenges faced by the public regarding the use of public transportation, which were analysed using this statistical technique, for the researcher to examine the challenges faced by the public when using public transportation in Kuala Lumpur.

Table 3. Statistical Technique in Data Analysis

No	Research Objectives	Statistical Techniques
1.	To identify the level of road congestion in Kuala Lumpur.	Descriptive Analysis (Mean and Standard Deviation)
2.	To examine a significant relationship between the effectiveness of public transportation usage measured in terms of (i) accessibility, (ii) punctuality, (iii) quality, (iv) infrastructure, (v) time consumption, (vi) cost, and (vii) environment on road congestion in Kuala Lumpur.	Pearson Correlation Analysis
3.	To determine the most contributing factors to the road congestion in Kuala Lumpur.	Multiple Regression Analysis
4.	To investigate the challenges faced by the public regarding the use of public transportation.	Descriptive Analysis

MAIN FINDINGS

Objective 1: To identify the level of road congestion in Kuala Lumpur

The first research objective of the study is to identify the level of road congestion in Kuala Lumpur. The researcher used the result of the mean score to measure the level of road congestion. Table 4 below indicates the interpretation level mean value suggested by Weirma (2000). Thus, in this study, the interpretation level of mean by Weirma (2000) has been used to identify the level of road congestion in Kuala Lumpur, which is the dependent variable of this study. The mean score with the value of 1.00 to 2.49 can be interpreted as a low level; meanwhile, the value of 2.50 to 3.49 for the mean score can be interpreted as a moderate level, and the value of 3.50 to 5.00 for the mean score can be interpreted as high, as shown in the table below.

From the analysis of the mean score, as shown in Table 5, the road congestion level in Kuala Lumpur is moderately high at a mean score of 3.13. This is because the mean score for the level of road congestion in Kuala Lumpur is within the range of 2.50 to 3.49 (Weirma, 2000). Thus, based on the result of the study that was carried out, it can be supported by the past study by Teh (2022), which stated that Malaysia had severe traffic congestion, especially in Kuala Lumpur, and the average journey to work is reportedly getting alarmingly longer than most drivers can remember from before the pandemic. Another study by Hazlin & Wu (2023) revealed that some road users of Kuala Lumpur traffic also stated that some traffic jams did not only happen during peak hours but could last for the whole day. Not only that, but this result is also supported by Kuyer (2023), who reveals that after the pandemic, the public is more confident and prefers to use their private vehicles more frequently than public transportation due to a lack of social separating space in public transportation; hence, the increased traffic congestion occurred due to this. Therefore, the result showing that there is a moderate level of road congestion in Kuala Lumpur is acceptable and satisfactory since several prior literature reviews also admit to the level of traffic congestion that has been happening in Kuala Lumpur.

Table 4. Interpretation of Mean (Source: Weirma (2020))

Mean Score	Interpretation Level
1.00 - 2.49	Low
2.50 - 3.49	Moderate
3.50 - 5.00	High

Table 5. Result for Mean and Standard Deviation of Road Congestion

Dependent Variable	Minimum	Maximum	Mean	Standard Deviation	Level of Assumption
Road Congestion	1.40	5.00	3.13	0.75	Moderately High

Objective 2: To examine a significant relationship between the effectiveness of public transportation usage measured in terms of (i) accessibility, (ii) punctuality, (iii) quality, (iv) infrastructure, (v) time consumption, (vi) cost, and (vii) environment on road congestion in Kuala Lumpur

The second research objective of the study is to examine a significant relationship between the effectiveness of public transportation usage measured in terms of (i) accessibility, (ii) punctuality, (iii) quality, (iv) infrastructure, (v) time consumption, (vi) cost, and (vii) environment on road congestion in Kuala Lumpur. Before adopting good measures, the relationship between the independent variables and the dependent variable was established using the Pearson Correlation Coefficient. Pearson Correlation is used in this study to measure the relationship between independent variables and the dependent variable. Thus, to indicate the strength of the relationship between the variables, the Rule of Thumb indicator has been used for the interpretation of the strength of the relationship between variables. Based on the Table 6 below, the strength of a relationship is based on correlation where ≤ 0.20 indicates no relationship between the variables, ± 0.21 to ± 0.40 means there is a weak relationship, ± 0.41 to ± 0.60 means there is a moderate relationship, ± 0.61 to ± 0.80 indicate to a strong relationship and ± 0.81 to ± 1.00 means there is a very strong relationship (Hair et al., 2015). According to correlation theory, there is a linear relationship between an independent variable and a dependent variable, considering the p-value is less than 0.05 to ascertain the relationship. The findings of the Pearson Correlation analysis between all the independent variables and the dependent variable, road congestion, are shown in Table 7.

Table 6. Rule of Thumbs (Source: Weirma (2020))

Size of Correlation	Interpretation of Relationship
± 0.81 to ± 1.00	Very strong relationship
± 0.61 to ± 0.80	Strong relationship
± 0.41 to ± 0.60	Moderate relationship
± 0.21 to ± 0.40	Weak relationship
≤ 0.20	No relationship

Table 7. Pearson Correlation Analysis

Independent Variables	Analysis			Relationship
	Correlation Result		N	
Accessibility	Pearson Correlation	0.30**	410	Weak relationship
	Sig. (2-tailed)	0.000		
Punctuality	Pearson Correlation	0.30**	410	Weak relationship
	Sig. (2-tailed)	0.000		
Quality	Pearson Correlation	0.30**	410	Weak relationship
	Sig. (2-tailed)	0.000		
Infrastructure	Pearson Correlation	0.30**	410	Weak relationship
	Sig. (2-tailed)	0.000		
Time Consumption	Pearson Correlation	0.30**	410	Weak relationship
	Sig. (2-tailed)	0.000		
Cost	Pearson Correlation	0.30**	410	Weak relationship
	Sig. (2-tailed)	0.000		
Environment	Pearson Correlation	0.40**	410	Weak relationship
	Sig. (2-tailed)	0.000		

The independent variables of this research are examined through the Pearson Correlation analysis and by looking at the correlation (r) value to determine the relationship of an independent variable with the dependent variable, road congestion. However, the findings of the second research objective showed independent variables: accessibility, punctuality, quality, infrastructure, time consumption, and cost, all showing a weak positive relationship with the dependent variable, road congestion. Meanwhile, a slightly different result can be seen for the final independent variable, the environmental relationship with road congestion, though it still falls within the category of weak positive correlation.

Thus, the result of the study that was carried out can be supported by the past study by Mohd Din et al. (2009), which has shown that the ease with which individuals can walk to transit stations significantly affects their willingness to use public transportation. This proves that accessibility somehow affects the effectiveness of public transportation usage. Besides, a study by Kamarudin et al. (2023) has highlighted challenges in this area, particularly for individuals with disabilities. For instance, mobility-challenged travellers, notably wheelchair users, encounter significant difficulties when navigating the city's public transportation system, which often lacks adequate facilities to accommodate their needs.

Furthermore, the public transportation system's punctuality, safety, security, and dependability were shown to be important factors in determining user satisfaction in a study by Anuar et al. (2023). According to the findings, enhancing punctuality may improve overall service quality and boost the use of public transit. This is further corroborated by a 2023 survey that found that 54% of Malaysians who use public transportation rank the lack of punctuality as their top grievance, highlighting the importance of punctuality in the customer experience (Reporters F.M.T, 2023). Additionally, according to the study by Hoo et al. (2023), only passengers who are pleased with the standard of public transportation are likely to use it again, as opposed to those who were unhappy

with the services they received.

Based on the findings in Table 7, it is proven that enhancing the quality aspects of public transportation can lead to increased user preferences for public transportation, thereby contributing to reduced traffic congestion. Not only that, according to Tan and Looi (2021), one of the many reasons why Malaysians do not wish to use public transit is due to the public transportation station's infrastructure, such as parking lots, waiting spaces, and restrooms. Moreover, a study by Majid et al. (2020) examining the impact of time attributes on Mass Rapid Transit (MRT) ridership in Kuala Lumpur found that travel time significantly affects users' decisions to use public transport. This is evidence that, though the correlation is weak, it still reflects the effectiveness of public transportation usage and its impact on road congestion. Next, because of reasonable rates and public transportation refunds, a monthly transportation expense of RM400 was deemed sustainable in a study on public travellers in the Klang Valley by Majid et al. (2022). This implies that fair pricing policies can promote more public transportation use, lessening dependency on private automobiles and easing traffic jams.

Finally, the correlation between environment and road congestion can be supported by a study by Huang et al. (2019) showing a positive correlation between pro-environmental behaviour and attitudes of public transportation users. The study also revealed that for short travels, those who are ecologically sensitive may feel strongly that they should walk, ride, or use public transportation rather than their car. Therefore, based on the correlation analysis's results and the discussion above, it can be concluded that all seven independent variables have a weak positive correlation with the dependent variable, road congestion.

Objective 3: To determine the most contributing factors to road congestion in Kuala Lumpur

Multiple regression can be used to explore the relationship between independent variables and the dependent variable. Although multiple regression is based on correlation, it allows a more sophisticated exploration of interrelationships among variables (Pallant, 2013). Multiple regression can predict a particular outcome from a set of variables and provide information about the model as a whole and the relative contribution of each variable of the variables involved in the model. The third research objective of the study is to determine the most contributing factors to road congestion in Kuala Lumpur. The Table 8 below indicates the coefficient value of an independent variable, accessibility, punctuality, quality, infrastructure, time consumption, cost, and environment towards the dependent variable, road congestion, is about 51.8%, which shows that the relationship between independent variables and dependent variable has a moderate relationship. This means that in this study, independent variables contribute 50% in determining road congestion as the dependent variable. Meanwhile, the value of R Square (R^2) reported at 0.268 indicates that the variance of road congestion can be explained by the independent variables, which are 26.8%. As shown in Table 9, multiple regression analysis was carried out to determine the predictors of road congestion. The analysis indicates that the most significant predictor of road congestion in Kuala Lumpur is the environment, with a beta (β) value of 1.393, and it has a significant influence on road congestion with a p-value of 0.000 ($p < 0.01$).

Thus, based on the result of the study that was carried out can be supported by the past study by United Nations Habitat (2024), stating that the environmental aspects of Kuala Lumpur's public transportation system significantly influence road congestion in the city. The finding was that an efficient and eco-friendly public transit network could reduce the number of private vehicles on the roads, alleviate traffic congestion, and lower carbon emissions. However, limited coverage, inadequate integration between different modes of transport, and insufficient capacity can deter users from opting for public transportation (United Nations Habitat, 2024). This reluctance increases reliance on private vehicles, exacerbating road congestion and environmental pollution. Therefore, based on the findings, it can be concluded that the independent variable, the environment, is the most contributing factor towards the dependent variable, road congestion in Kuala Lumpur.

Table 8. Multiple Regression Model Summary

Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate
1	0.518	0.268	0.255	0.65133

Table 9. Multiple Regression Analysis

	Beta (β)	Sig.
(Constant)		0.000
Accessibility	0.123	0.630
Punctuality	-0.356	0.025
Quality	-0.825	0.000
Infrastructure	0.251	0.318
Time Consumption	0.395	0.032
Cost	-0.655	0.003
Environment	1.393	0.000

Objective 4: To investigate the challenges faced by the public regarding the use of public transportation

The final research objective is to investigate the challenges the public faces regarding public transportation. The researcher used the results of percentages to measure the challenges faced by the public regarding public transportation. Table 10 below shows the cumulative percentage of respondents' answers that answered the question with "Agree" and "Strongly Agree," admitting that the independent variables, such as accessibility, punctuality, quality, infrastructure, time consumption, cost, and environment, are the challenges that they face when using public transportation in Kuala Lumpur. Hence, based on Table 10, the most challenging factor faced by the public in using public transportation is the first independent variable, which is accessibility, where 24.9% of respondents agreed that public transportation in Kuala Lumpur lacks accessibility to ensure the effectiveness of public transportation usage. Meanwhile, punctuality and cost of public transportation were marked as the second most challenging factor by 22.2% of respondents, followed closely by time consumption, infrastructure, and quality of public transportation with 20.7%, 20.4%, and 20.3% respondents, respectively. Finally, the least challenging factor determined by respondents is the final independent variable, environment, with only 19.8% of the respondents recognising the environment as a challenge for them to use public transportation in Kuala Lumpur.

Thus, the study's result can be supported by a past study by Kamarudin et al. (2023), which stated that there are difficulties in making public transport accessible, especially for people with impairments. For example, the public transportation system in Kuala Lumpur, which frequently lacks facilities to meet their needs, presents significant challenges for travellers with mobility impairments, particularly those who use wheelchairs. Additionally, research by Mohd Din et al. (2009) has shown that the ease with which individuals can walk to transit stations significantly affects their willingness to use public transportation. Thus, without proper accessibility for the users to reach the public transportation stations, it will become a challenge for them to utilise the public transportation system around them entirely. Not only that, but Dut (2017) also revealed that due to many users thinking that accessibility should be the top goal when encouraging the use of public transportation, the connectivity issue between stations has consequently become a factor that discourages users from using it. Consequently, it can be concluded that the accessibility factor has been the most challenging factor faced by the public when using public transportation in Kuala Lumpur.

Table 10. Percentages for Challenges of Using Public Transportation in Kuala Lumpur

Variables	Details	Percentage (%)
Challenges of Using Public Transportation in Kuala Lumpur	Accessibility	24.9
	Punctuality	22.2
	Quality	20.3
	Infrastructure	20.4
	Time Consumption	20.7
	Cost	22.2
	Environment	19.8

CONCLUSION

This study aims to examine the effectiveness of public transportation usage and its impacts on road congestion in Kuala Lumpur. Seven initial factors: accessibility, punctuality, quality, infrastructure, time consumption, cost, and environment guided the effectiveness of public transportation usage. Overall, the researcher successfully addressed all of the research objectives and hypotheses. According to this chapter's findings, the road congestion level in Kuala Lumpur is moderate. Though all seven independent variables covered accessibility, punctuality, quality, infrastructure, time consumption, cost, and environment, they have a significant yet weak relationship with the road congestion issue in Kuala Lumpur. The last independent variable, environment, was revealed to be the most continuous variable towards the dependent variable, road congestion. As for the final objective, it is proven that accessibility has been the most challenging factor for users when using public transportation. Based on this research, a few recommendations can be identified to encourage potential improvements in the effectiveness of public transportation usage to reduce road congestion in Kuala Lumpur. One of the suggestions is that Kuala Lumpur's public transportation systems can become more effective, dependable, and user-friendly by prioritising and enhancing operational improvements. Besides, transportation design that strongly emphasises inclusivity and community involvement may also better serve the diverse requirements of Kuala Lumpur's people. Additionally, related authorities can establish a city where public transportation is essential to everyday life by incorporating sustainable urban planning ideas into transportation research and policy.

COMPETING INTEREST

The author declares no competing interests.

COMPLIANCE WITH ETHICAL STANDARDS

All participants were given a consent form that required them to sign and agree to participate in this study.

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