



RANKING FACTORS AFFECTING PUBLIC TRANSPORT MODE CHOICE OF COMMUTERS IN AN URBAN CITY USING THE ANALYTIC HIERARCHY PROCESS: THE CASE OF SURABAYA, INDONESIA

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<p>Info Article</p> <p>Received : 09 Oktober 2025</p> <p>Revised : 11 November 2025</p> <p>Accepted : 02 Desember 2025</p> <p>Publication : 30 Desember 2025</p> <p>Keywords: Public Transport, Commuters, Surabaya, Analytic Hierarchy Process (AHP), Mode Choice</p> <p>Kata Kunci: Transportasi Umum, Komuter, Surabaya, Analytic Hierarchy Process (AHP), Pilihan Moda</p> <p>Licensed Under a Creative Commons Attribution 4.0 International License</p> 	<p>Abstract. <i>This study aims to identify and rank the factors influencing commuters' public transport choices and to evaluate their preferences for different modes of transport. A quantitative survey was conducted with 63 provided consistent responses based on the Analytic Hierarchy Process (AHP). Four decision criteria were assessed: cost, safety, time efficiency, and comfort. Alongside five public transport alternatives: city bus, intercity bus, feeder bus, commuter train, and public minivan. Results revealed that time efficiency is the most influential factor shaping commuters' choices, followed by safety, cost, and comfort. In terms of mode preference, the commuter train ranked highest, reflecting its reliability and punctuality, while public minivan ranked lowest, primarily due to declining service quality and competition from ride-hailing services. These findings highlight the need to prioritize service reliability of time efficiency, safety, and affordability to increase public transport usage in Surabaya.</i></p> <p>Abstrak: Studi ini bertujuan untuk mengidentifikasi dan mengurutkan faktor-faktor yang mempengaruhi pilihan angkutan umum para commuter serta mengevaluasi preferensi mereka terhadap berbagai mode transportasi. Survei kuantitatif dilakukan dengan 63 responden yang memberikan tanggapan konsisten berdasarkan Proses Hierarki Analitik (AHP). Empat kriteria keputusan dievaluasi: biaya, keamanan, efisiensi waktu, dan kenyamanan. Bersama dengan lima alternatif transportasi umum: bus kota, bus antar kota, bus feeder (Wira-Wiri), kereta api komuter, dan angkutan umum minivan (Angkot). Hasil menunjukkan bahwa efisiensi waktu merupakan faktor paling berpengaruh dalam menentukan pilihan pengguna transportasi umum, diikuti oleh keamanan, biaya, dan kenyamanan. Dalam hal preferensi moda transportasi, kereta api komuter menempati peringkat tertinggi, mencerminkan keandalan dan ketepatan waktunya, sementara angkot menempati peringkat terendah, terutama karena penurunan kualitas layanan dan persaingan dari layanan ride-hailing. Temuan ini menyoroti perlunya memprioritaskan keandalan layanan, efisiensi waktu, keamanan, dan keterjangkauan untuk meningkatkan penggunaan transportasi umum di Surabaya.</p>
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INTRODUCTION

Transportation plays a vital role in the movement of people and goods, serving as a backbone for societal and economic activities. With the rise of industrialization and urbanization, the demand for transportation has grown proportionately (Mayo & Taboada, 2020). Defined broadly as any mode of transport available for public use, including buses, trains, and public minivan (Preston, 2009). In modern society, public transportation has become indispensable for addressing urban mobility challenges. For instance, a study by Lako and Gjevori (2003) in Europe examined urban public transport issues, revealing that improvements to the transit system could alleviate congestion, reduce emissions, lower costs, and minimize road accidents, all while enhancing accessibility. Similarly, effective transit systems are recognized for their environmental benefits, reinforcing their priority in funding decisions (Transportation Research Board, 1994, in Eboli & Mazzulla, 2012). The United Nations (2021) also emphasizes its accessibility, affordability, and inclusivity as essential factors for improving urban mobility and reducing reliance on private vehicles.

Globally, studies have identified key factors influencing public transport mode choice. In the Philippines, safety, cost, and availability emerged as critical determinants (Mayo & Taboada, 2020). In Taiwan, factors such as income, household vehicle ownership, and proximity to transport stops were significant (Liu, 2017). Similarly, research comparing public transport preferences in New Delhi and New York highlighted fare, safety, and reliability as decisive factors, with cost being especially critical in developing while developed countries prioritized safety and reliability (Kumar & Ganguli, 2018). According to research from the University of Sydney (Daniels & Mulley, 2013) the access from home and bus stop also play an important role for people to choose public transportation.

Indonesia has actively invested in developing various modes of public transport to support urban mobility (INVI Indonesia, 2024). Despite these efforts, Surabaya's public transportation system remains inadequate, leading many residents to rely on private vehicles. In fact, approximately 57.14% of residents use privately owned motorcycles for daily travel, while only 14.29% opt for public transport (Nathenia & Ginting, 2024).

Several factors influence this preference. Key systems such as the Suroboyo Bus often lack coverage in certain areas and struggle to maintain consistent headway times (Pratama, Indarti, & Rahmadanik, 2024). Accessibility also poses major challenges.

Public transport in Surabaya is largely non-inclusive for persons with disabilities, with bus stops and vehicles lacking proper access lanes, ramps, and other facilities for wheelchair users. Similarly, guiding blocks for the visually impaired are often poorly maintained and obstructed (Nathenia & Ginting, 2024).

However, despite valuable global insights and the pressing urban mobility challenges in Indonesia, there remains a significant research gap. While statistical data highlight the dominance of private vehicles, a comprehensive understanding of the relative weight of key factors such as time, cost, and comfort in influencing commuter mode choice is still lacking. Furthermore, global studies, while informative, may not fully apply to the unique context of Surabaya, with its specific traffic congestion and socioeconomic dynamics, which requires a tailored analysis. This lack of structured analysis on the hierarchy of commuter preferences also presents a challenge for policymakers, as investment and improvement efforts risk being ineffective without understanding the factors that matter most to the public. Therefore, this study aims to bridge this research gap by applying the Analytic Hierarchy Process (AHP) to provide a deeper, perception-based understanding of the factors most influential in transport mode choice in Surabaya.

Meanwhile, the sharp increase in private vehicle ownership has exacerbated congestion in Surabaya. Average annual hours lost to traffic rose from 62 hours in 2021 to 76 hours in 2024 (Nugraha, 2022; Tomtom, n.d.). These conditions highlight the urgent need to improve public transport quality. Understanding the factors that influence commuters' choices is essential for designing efficient and user-friendly systems (Cruz, 2024). Public transportation also has the potential to alleviate congestion, reduce pollution, and enhance tourism (Tridjono, 2011). By applying the Analytic Hierarchy Process (AHP), the study provides a structured, multi-criteria decision-making framework that captures user perceptions and priorities. The findings will offer valuable insights for urban planners and policymakers to guide improvements and future investments in Surabaya's public transport system. This study aims to (1) identify and rank the key factors influencing commuters' mode choice and (2) determine the preferred transport mode in Surabaya.”.

METHOD

This study employed a quantitative research design, characterized by formal, objective, and systematic procedures in which data are numerically measured and

analyzed (Mason, 2013). A survey design was used to collect data on participants' demographic profiles, their frequently used transportation modes, their preferences regarding the factors influencing public transportation choices and the relative effectiveness of different transport modes in Surabaya.

Two versions of the questionnaire were developed: an offline version and an online version. The offline questionnaires were distributed at public bus stops and to students on a university campus in Surabaya, while the online version was disseminated via Google Forms. Data collection was conducted over a two-month period, from April 1 to May 30, 2025.

The questionnaire consisted of four sections. The first section collected demographic information, including gender, residential address, and workplace or study location. The second section asked participants to indicate the most common modes of public transportation they used. Although some respondents reported using online ride-hailing services (e.g., Grab, Gojek) for daily travel, these responses were excluded from the analysis, as the study focused only on formal public transportation systems. The third section asked participants to evaluate factors influencing their choice of public transportation. Four criteria were assessed: cost, safety, time efficiency, and comfort. And the fourth section, five alternative transportation modes in Surabaya were evaluated: city bus (Bus Kota), intercity bus (Bus Antar Kota), feeder bus (Wira-Wiri), commuter train (Kereta Api Komuter), and public minivan (Angkot).

For the third and fourth sections of the questionnaire, the Analytic Hierarchy Process (AHP) was used. Participants performed pairwise comparisons of both criteria and transportation modes on a nine-point scale adapted from Saaty (1987). On this scale, a score of 1 indicated equal importance, while scores of 3, 5, 7, and 9 represented moderate, strong, very strong, and extreme importance, respectively. Intermediate values (2, 4, 6, 8) were used for compromise judgments.

Each participant completed six pairwise comparisons for the four criteria and ten comparisons for the five transportation modes. The same data encoding and analytical procedures were applied to both sets of comparisons. The AHP method was then applied to determine the relative importance of the criteria and to rank transportation modes. The overall objective was to identify the most influential factors shaping public transportation choices and to determine the most preferred transportation mode across demographic groups.

A total of 73 participants initially took part in the survey, each providing pairwise comparison judgments for the criteria factors influencing transportation choices as well as for the transportation modes. These comparisons were conducted using the standard 1–9 Saaty scale, where participants expressed the relative importance of each factor and mode.

To ensure the logical consistency of the judgments, the Consistency Ratio (CR) was calculated for each pairwise comparison matrix using an AHP calculator. Following Saaty's (1987) guideline, a CR value below 0.10 was considered acceptable, indicating that the judgments were consistent and reliable. Out of the 73 responses, 10 participants had CR values greater than 0.10, which indicated inconsistent judgments, and therefore these responses were excluded from further analysis. As a result, the final analysis was based on 63 valid responses.

Descriptive analysis was then conducted to summarize key characteristics of the participants and the transportation most frequently used daily by respondents. The analysis covered three aspects: first, the demographic profile of participants, including age, gender, residential zone, and workplace or study zone. Second, the frequency of transportation modes used, which allowed multiple selections and therefore produced a total frequency of 65 modes despite having 63 participants; and third, the mean values of the consistent AHP weights, which were calculated for both the criteria factors influencing transportation choices (such as cost, comfort, safety, and accessibility) and for the transportation modes themselves (City bus (bus kota), Inter city bus (bus antar kota), Feeder bus (wira-wiri), Commuter train (kereta api komuter), and public minivan (angkot).

RESULTS AND DISCUSSION

Results

After data screening, a total of 63 valid responses were included in the analysis. The results are presented in three parts. First, the demographic profile of the participants is described to provide an overview of the sample population. Second, the frequency and distribution of transportation modes regularly used by the respondents are reported. Finally, the mean values of the consistent AHP weights are presented for both the criteria factors influencing transportation choices and the transportation modes themselves.

Participants characteristics

The descriptive analysis showed a total of 63 participants took part in this study. Of these, 38 (60.3%) were under the age of 40, while 25 (39.7%) were aged 40 and above. Regarding residential location, 33 participants (52.4%) lived in West Surabaya, 9 (14.3%) in East Surabaya, 6 (9.5%) in North Surabaya, 9 (14.3%) in South Surabaya, and 6 (9.5%) were non-residents of Surabaya but stayed in the city for work or study purposes. In terms of workplace or study location, 45 participants (71.4%) worked or studied in West Surabaya, 1 (1.6%) in East Surabaya, 11 (17.5%) in North Surabaya, and 6 (9.5%) in South Surabaya.

Table 1. Descriptive Statistic The Participants Demographic characteristics

Variable	Category	N	%
Age	Under 40	38	60.3
	40 and older	25	39.7
	Total	63	100
Address Zone	West Surabaya	33	52.4
	East Surabaya	9	14.3
	North Surabaya	6	9.5
	South Surabaya	9	14.3
	Non residents of Surabaya	6	9.5
	Total	63	100
Work place/study place zone	West Surabaya	45	71.4
	East Surabaya	1	1.6
	North Surabaya	11	17.5
	South Surabaya	6	9.5
	Total	63	100

Transportation commuters regularly used by Surabaya residents

Since participants were allowed to select more than one mode of transportation, the total frequency of reported modes (65) slightly exceeded the number of participants (63). In addition, although some respondents mentioned online-based public transportation, these responses were excluded from the analysis to focus only on traditional public transport modes.

The descriptive statistics show the distribution of transportation modes regularly used by Surabaya residents in the sample. Among the 63 participants, the most commonly used mode was the city bus (*bus kota*), reported by 20 participants (31.25% of commuters), accounting for 30.77% of the total transportation mode choices. This

indicates that the city bus is the dominant public transport option among the respondents. The feeder bus (*wira-wiri*) was the second most frequently used, chosen by 15 participants (23.44% of commuters) and representing 23.08% of total mode choices. The intercity bus (*bus antar kota*) followed, with 11 participants (17.19%), making up 16.92% of total choices. The commuter train (*kereta api komuter*) was used by 10 participants (15.63%), contributing 15.38% of total choices, while the public minivan (*angkot*) was the least common, selected by 9 participants (14.06%) and comprising 13.85% of the total choices.

Table 2. Descriptive Statistics Transportation Modes Regularly used by Surabaya Residents

Transportation mode	Frequency	% of commuters	% total of mode choice
<i>Bus kota</i> (City bus)	20	31,25	30,77
<i>wira-wiri</i> (Feeder bus)	15	23,44	23,08
<i>Bus antar kota</i> (Inter city bus)	11	17,19	16,92
<i>Kereta api Komuter</i> (commuter train)	10	15,63	15,38
<i>Angkot</i> (public minivan)	9	14,06	13,85
Total	65		100

Criteria influencing public transportation choices in Surabaya

Based on the descriptive statistics from the AHP analysis of criteria influencing public transportation choices in Surabaya, time efficiency emerged as the most important factor, with a mean weight of 0.2743 and ranked first. This indicates that commuters prioritize speed, reliability, and timely service when selecting public transportation. Safety was the second most important criterion, with a mean of 0.2692, reflecting a strong concern for personal security during travel. Cost followed in third place with a mean of 0.2325, suggesting that while affordability is considered, it is less influential compared to time and safety. Comfort was ranked last with a mean of 0.2256, indicating it is the least prioritized factor, though still relevant. The standard deviations show moderate variability in responses, particularly for cost, implying differing opinions across respondents. Overall, the results suggest that improving punctuality and safety should be the top priorities for enhancing public transportation in Surabaya, followed by affordability and comfort as secondary considerations.

Table 3. Descriptive Statistic Ranking of Criteria factors in choosing public transportation in Surabaya

Createria	N	Mean	Std. Deviation	Rank
Cost	63	0.2325	0.17486	3
Safety	63	0.2692	0.12771	2
Time efficiency	63	0.2743	0.14078	1
Comfortable	63	0.2256	0.14754	4
Valid N (listwise)	63			

Preference for different public transportation modes

The descriptive statistics reveal the relative preference for different public transportation modes among 63 respondents in Surabaya. The commuter train (Kereta Api Komuter) is ranked as the most preferred mode, with the highest mean score of 0.2783, indicating that it is perceived as the most favorable option by commuters. This suggests that the commuter train is valued for its reliability, efficiency, or comfort compared to other options. The city bus (Bus Kota) follows in second place with a mean of 0.2113, reflecting its widespread use and accessibility within the city. The feeder bus (*Wira-wiri*) ranks third with a mean of 0.2006, showing moderate popularity, likely due to its role in connecting peripheral areas to major transit hubs. The intercity bus (Bus Antar Kota) is ranked fourth with a mean of 0.1935, indicating lower preference, possibly because it is used less frequently for daily commuting within Surabaya. Lastly, the public minivan (*Angkot*) has the lowest mean score of 0.1179, ranking fifth, suggesting limited preference—possibly due to issues such as overcrowding, inconsistent schedules, or poor service quality. The standard deviations are relatively low across all modes, indicating consistent perceptions among respondents. Overall, these findings highlight the growing importance of the commuter train in Surabaya's public transport system, while also pointing to opportunities for improving the appeal and performance of other modes like public minivan (*Angkot*) and intercity buses.

Table 4. Descriptive Statistic Ranking Public Transportation in Surabaya

Public transportation mode	N	Mean	Std. Deviation	Rank
<i>Bus kota</i> (City bus)	63	0.2113	0.1313	2
<i>Bus antar kota</i> (Inter city bus)	63	0.1935	0.10241	4
<i>wira-wiri</i> (Feeder bus)	63	0.2006	0.12389	3
<i>Kereta api Komuter</i> (Commuter train)	63	0.2783	0.15833	1
<i>Angkot</i> (Public minivan)	63	0.1179	0.10247	5
Valid N	63			

Discussion

A Comparative Analysis: Local Findings Versus International Perspectives

The findings of this study both align with and diverge from international perspectives on factors influencing public transportation choices. Kumar and Ganguli (2018) found that safety and reliability are decisive factors in transportation decisions, with cost being particularly critical in developing countries, while developed nations tend to prioritize safety and reliability over cost. In the Indonesian context, however, this study reveals a slightly different hierarchy: time efficiency emerged as the most important factor, followed by safety, cost, and comfort as the least prioritized. This suggests that in densely populated urban centers like Surabaya, accessibility and speed of service are paramount, reflecting the high demand for efficient mobility in congested environments.

These findings resonate with the United Nations (2021), which emphasizes accessibility, affordability, and inclusivity as key pillars of sustainable urban mobility and reducing dependence on private vehicles. The strong preference for time efficiency in this study can be interpreted as a reflection of accessibility, since faster and more direct routes improve access to jobs, education, and services critical needs in fast-growing cities.

Success in Adopting Modern Public Transportation

In terms of transportation mode choice, commuter train (*Kereta Api Komuter*) ranked first in this study, which aligns with findings from Naurah (2025), where the train was identified as the most preferred mode due to its punctuality and affordability. These attributes make it a favorable option, especially in a congested urban environment like Surabaya where time efficiency is the top-ranked factor. Furthermore *Bus Kota* and *Wira-Wiri* ranking as the second and third most preferred modes among respondents. The introduction and improvement of modern public transportation services by the Surabaya government appear to have achieved a degree of success. Moreover it was supported by the finding that the the intercity bus (*Bus Kota*) and the feeder bus (*Wira-Wiri*) also emerged as the most regularly used modes for daily commuting in Surabaya, ranking first and second in terms of actual usage. Taken together, these results highlight the effectiveness of recent improvements in making these services both widely adopted and positively perceived by the public.

The Struggle of Conventional Transport: Challenges and Negative Perceptions

In contrast, intercity bus (*Bus Antar Kota*) and public minivan (*Angkot*) remained in fourth and fifth place, respectively, indicating that these conventional modes have seen limited improvements in service quality, comfort, safety, and overall public perception. For trips beyond city limits, many commuters prefer the Commuter Train (*Kereta Api Komuter*). According to Pinasthika (2025), this preference stems from the commuter train's punctuality, affordability, and relative comfort, making it a reliable option for intercity and regional travel. In contrast, The intercity bus (*Bus Antar Kota*) is often avoided due to perceptions of inconvenience including overcrowding, poor ventilation (making it uncomfortably hot), and safety concerns. Although Pinasthika (2025) notes recent improvements in service quality, these changes have not yet significantly shifted public perception or usage patterns. Similarly, public minivan (*Angkot*) has lost popularity according to Putera (2019) highlights that the rise of online ride-hailing services (e.g., Gojek, Grab) has significantly reduced reliance on public minivan (*Angkot*), as digital platforms offer greater convenience, door-to-door service, real-time tracking, and perceived safety. As a result, public minivans (*Angkot*) are increasingly viewed as outdated, unreliable, and less accessible in comparison.

Finally, the results of this study should be interpreted with caution due to several limitations. The sample size was relatively small, and more than half of the participants (52.4%) resided in West Surabaya, with the majority (74.1%) also working in the same area. This geographical concentration may limit the generalizability of the findings across the entire city. In addition, the age distribution of respondents lacked variety, as no young commuters under 18 years old were represented in the sample.

Limitations of the Study

The results of this study should be interpreted with caution due to several limitations. The relatively small sample size, heavily concentrated in West Surabaya, with most participants also working in the same area, limits the generalizability of the findings across the entire city. Additionally, the age distribution of respondents lacked variety, as no commuters under 18 years old were represented in the sample. For future research, it is recommended to expand the geographical and demographic scope of the sample to ensure more representative findings.

CONCLUSION

In the urban context of Surabaya, the most important factor influencing transportation mode choice is time efficiency, followed by safety, cost, and comfort as the least prioritized. This indicates that commuters place a high value on punctuality and speed. In terms of transportation mode preference, the Commuter Train (Kereta Api Komuter) ranks first, primarily due to its on-time performance and relative comfort make it reliable. The city bus (Suroboyo Bus) and Feeder bus (Wira-Wiri) rank second and third, respectively, suggesting that recent improvements by the Surabaya city government have been moderately successful in enhancing public perception and usage of modern public transportation. In contrast, intercity bus (Bus Antar Kota) ranks fourth. It remains less preferred due to concerns about overcrowding, inconsistent schedules, and safety. Meanwhile, public minivans (Angkot) ranks last, largely due to the rising popularity of online ride-hailing services such as Gojek and Grab, which offer greater convenience, accessibility, and door-to-door service.

Improve Service Reliability and Frequency Increase the frequency of buses and commuter trains, especially during peak hours, to reduce waiting times and improve time efficiency.

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