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Prioritizing Public Transportation Mode Choice in Jakarta's Satellite Cities: An AHP-Based Approach

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Abstract

This study aims to determine and prioritize the factors that affect the choice of public transportation modes in Jakarta's satellite cities (Depok, Tangerang, Bekasi, and Bogor) by employing the AHP methods. The paper proposed a study on the impacts of travel cost, travel time, comfort, possibility of access, reliability, and government policies affecting the choices individuals make when they take modes of transportation to travel. The opinions of the decision makers were solicited, and pairwise comparison was employed to obtain relative weights of factors. The most important factors are reliability and regularity (13.89%), followed by comfort (12.61%) and accessibility (11.72%). While travel costs are still important, they stay relatively lower (8.43%) than others, implying that commuters are more concerned with reliability and comfort than cost. Social and psychological were the next highest in the AHP ranking and influenced less daily travel behavior choices. The results contribute to recommendations for policymakers to improve public transport in Jakarta's satellite cities, emphasizing service reliability, comfort, and accessibility. Additional work should be conducted to investigate the effects of environmentalism, digital technologies in transportation, and user segments' preferences.

Keywords: Public Transportation, Mode Choice, Jakarta Satellite Cities, Analytic Hierarchy Process (AHP), Reliability, Comfort, Accessibility, Travel Cost, Government Policy, Transportation Planning

1. Introduction

The other issue is connected to the fact that Jakarta and its neighboring satellite cities are facing severe transportation problems, which are negatively affecting the economic growth and quality of life of the people who inhabit this area (Purnomo et al., 2020). Improper urbanization rates and population growth are far faster than the increase in the number of means of transportation, so excessive traffic congestion, long travel times, and the contamination of the environment have become noticeable (Farda & Lubis, 2018). The city's transportation system is overwhelmed by a rapidly growing number of private cars, which contribute to congestion and immobilization (Nurcahyo et al., 2020). Despite being available, public transport tends to be private cars due to problems of coverage, less dependable service, and a low service integration system (Muhtadi & Trisnawan, 2020). Using private means of transportation contributes to traffic jams and air pollution, which harms public health and the environment (Dahlan & Fraszczyk, 2019). This is evidenced by only 24% of the 47.5 million daily trips within Jakarta use pub-

lic transportation (Siburian et al., 2020). To ease congestion, road widening has made motorized movement more attractive and penalized walking and cycling (Hidayati et al., 2019). Therefore, there is a pressing need to refocus attention on public transportation as an attractive mode for commuters in Jakarta and its satellite cities.

Traffic congestion in Jakarta and its satellite cities leads to substantial economic losses due to wasted time and fuel consumption, increased logistics costs, and reduced productivity. Air pollution, mainly from vehicle emissions, poses serious health risks to residents, contributing to respiratory illnesses, cardiovascular diseases, and other health problems. Over-dependence on private vehicles contributes to greenhouse gas emissions, exacerbating climate change and its associated environmental consequences (Rukmana, 2018). Congestion is worsened by the daytime population of Jakarta being a combination of Jakarta citizens and people working in Jakarta from surrounding cities such as Bogor, Depok, Tangerang, and Bekasi (Febriani et al., 2020). The increasing demand for mobility coupled with significant transportation demand because of urban development are some of the reasons for such traffic (Hadi et al., 2018).

The promotion of mass transportation and the consistent effort to address the transport problem of Jakarta bring environmental sustainability, economic efficiency, and social justice together. An efficient, organized inter- and intra-city public transport will substantially reduce traffic jams by providing an alternative to privately owned vehicles, making commuters resort to modern forms of transport (Najid, 2019). Mass transit has the potential to be one of the most effective mechanisms to reduce air pollution, especially with the addition of cleaner technologies like electric buses and trains. In addition, public transportation promotes social equity because it is an affordable option accessible to all people, such as low-income riders, students, and seniors. Because the public highly uses mobile phones, and the Global Positioning System feature is available on mobile phones (A'rachman et al., 2022), the transportation mode in Jakarta can be integrated with mobile phones.

Better mass transit means less traffic, less smog, more effortless mobility, and a higher standard of living. It can do all this and more for Jakarta and its surrounding cities. Less congestion also means lower travel times, greater productivity, and less fuel, all amounting to substantial economic benefits for people and businesses. Also, less air pollution would not only benefit people's health, reducing their exposure to dirty air and preventing that strain on the health care system, but it also would help to address some of these environmental impacts of the transportation system. Improved access allows all citizens to benefit from employment opportunities, education, healthcare, and other key services irrespective of economic status or geographical location. The Jakarta MRT is a problem-solving tool that the government provides to solve problems in Jakarta by alleviating the levels of congestion and pollution (Ratnawati, 2021).

Jakarta's better public transport has the potential to unlock a chain of positive results, giving solutions to the city's multi-level problems (Ratnawati, 2021; Sitanggang et al., 2020). Better public transportation helps level the playing field of resources and opportunity. It offers opportunities for all people to access affordable and convenient mobility, ensuring active participation in the city's economic, social, and cultural services (Farda & Lubis, 2018; Ratnawati, 2021). At its core, improved public transportation means better economic productivity, public health, and urban sustainability, making Jakarta far more livable and prosperous for its residents. The presence of the MRT in the Senayan district accommodates pedestrians' comfort, but some deficiencies can be addressed to make pedestrians feel comfortable (Kusumawati et al., 2020).

The construction of priorities and promoting credible public transportation that is integrated and efficient for Indonesia, especially in Jakarta and satellite cities, also create opportunities and challenges. One of the main challenges is the fragmented institutional and regulatory environment, with numerous government strata and various authorities having overlapping powers. A further difficulty is ensuring investment in infrastructure and operational subsidization against competing claims for using public resources and the period of transport investments. Moreover, on top of that, it is nigh impossible to change the mindset of private vehicle users to that of use of public transport. Indonesia can also learn from Japan, which has managed such (trains/transit) solutions well. Addressing these barriers will require collaboration across all parties, including governments, private sector partners, and civil society organizations, and greater coordination to promote the right transport and communication solutions (Ernst & Sutomo, 2010).

The necessity of designing and enhancing urban public transportation modes in Jakarta satellite cities is growing due to the need for an efficient, sustainable, and egalitarian transportation system that caters to the necessity of growing megapolitan population. If these challenges are unmet, congestion, pollution, and inequality will continue to spiral, choking off economic opportunity and quality of life for millions of citizens. By investing in public transit and embracing transit-oriented development, Jakarta and its satellite cities can build a healthier, wealthier, and greener future for all (Ratnawati, 2021). One of the disused facilities is the sidewalk, which was created for pedestrians to walk on foot (Arifah & Hidayah, 2021). Pedestrian areas are also narrow or disappear; if there is a pedestrian area, it cannot provide benefits and advantages for pedestrians (Arifah & Hidayah, 2021). Successfully adopting Transit-Oriented Development (TOD) principles in developing the transit hubs can improve Jakarta's urban structure and land use and facilitate more compact, walkable, and sustainable neighborhoods (Tanudjaja et al., 2020).

This study examines the use of the Analytic Hierarchy Process in determining the ranking of factors that influence the choice of public modes of transportation in Jakarta's satellite cities and contributes to existing knowledge. Many studies have used the AHP in various applications, including supplier selection, project management, and water resources management. The factors are a user-friendly pedestrian environment and affordability, level of public transportation, pedestrian facilities, and compact and mono-development plan. Finally, the results of these studies are helpful for policymaking and investment options for sustainable transportation and measuring the well-being of Jakarta's riders and other related areas. Bekasi Station exemplifies these issues, as pedestrian facilities intended for easy mode transfers are hindered by street-level vending and unauthorized parking, which obstruct proper usage. (Rukmana et al., 2023). Intermodal pedestrians should become the focus of the buildout of the transportation infrastructure.

Modal choice theory tries to explain and predict how an individual decides on which mode of transportation to use for a particular trip. Among these are travel time, expense, convenience, comfort, safety, reliability, and access. According to the theory, when faced with several alternatives, people would evaluate the potential outcomes of each alternative and then choose how much of their potential to 'spend' on selecting one (Sakinah et al., 2018) to maximize their total utility or satisfaction. The theory explicitly describes the necessity of comprehending the complicated relationship among multiple drivers of travel behavior and the role of transportation systems and policies in context. Another way is to decrease private vehicles to increase the urban quality of life (Kusumawati et al., 2020). By evaluating customer satisfaction, companies will know which areas to improve and which to sustain, eliminate, and mini-

mize (Tjitrohartoko & Saraswati, 2020). This method provides a broader and more nuanced insight into travel behavior and can contribute to public effectiveness and sustainability in interventions in transport. Hopefully, the paper will promote understanding the decision-making process in transport planning and policymaking for policymakers and urban stakeholders in Jakarta's satellite city. The present study seeks to contribute to this essential aspect of the decision-making process in transportation planning, which could be of interest to policymakers and urban planners in the satellite cities of Jakarta that endeavor to devise more sustainable, efficient, and equitable transport systems.

This study's main objective is determining and ranking the factors affecting passengers' mode choices in Jakarta's satellite cities based on AHP. The AHP approach permits decision-makers to consider quantitative and qualitative aspects in a structured way and, therefore, a more integral valuation of transportation needs. This work aims to give actionable recommendations for policy decision-making and investment strategies for sustainable transportation and a better quality of life for the inhabitants in Jakarta and its satellite cities (Teoh & Khoo, 2015). AHP structures and prioritizes the criteria (Awasthi & Chauhan, 2011). The goals, procedures, results, and conclusions of phenomena underlying traffic congestion should be the grounds for providing efficient transportation and policymaking to reduce and provide safe, clean, accessible, and convenient mobility to the most fragile people (Parikesit & Bambang, 2012). This prioritization is important because it enables policymakers to concentrate resources and effort on the most beneficial interventions and to achieve the greatest return on transportation investments.

Applying the Analytic Hierarchy Process is crucial for prioritizing the elements influencing public transportation mode choice in Jakarta's satellite cities and offers a structured framework for decision-making (Timisela et al., 2021). The Analytic Hierarchy Process is especially helpful because it offers a methodical way to deal with intricate choices with numerous, frequently contradictory criteria (Hamlat et al., 2021). The AHP can assist decision-makers in decomposing complex problems into smaller ones, making the problems more manageable enabling them to assess the relative importance of several factors, and make well-informed judgments (Smith & Tighe, 2006). The decision-making process is getting more complex, especially when dealing with cost efficiency, so the Analytic Hierarchy Process was chosen to help with the decision-making task (Samah et al., 2006). By enabling the incorporation of financial and non-financial factors, AHP becomes a flexible and potent tool for tackling intricate decision problems (Gothwal & Saha, 2015). AHP can deconstruct complex issues into hierarchical structures and help decision-makers by facilitating the systematic evaluation of various criteria and options and enhancing its strength in decision-making.

An additional objective of this study is to ascertain the relative importance of each factor in order to establish a hierarchical ranking of their respective priorities. This is imperative for the effective allocation of resources and the development of policies within the transportation sector. The relative significance of each factor can be evaluated by assigning weights, enabling decision-makers to concentrate their efforts on the most effective interventions. It helps to decompose complex problems into their basic components to individually analyze every aspect based on different criteria (Sangiorgio et al., 2021). The Analytic Hierarchy Process method divides the problem into sections as a hierarchical model by imitating the human brain's complex concepts to make the right decision based on the available information (Sakmongkoljit et al., 2021). The weight calculation process involves the comparison of criteria in pairs, enabling decision-makers to express their preferences and evaluate the relative importance of each factor. This approach has been applied in various fields, including determining optimal delivery routes for

trucks, assessing supply chain efficiency, and the decision-making process regarding crisis management strategies.

This research aims to answer some important research questions: 1) Which main factors affect mode choice in satellite cities in Jakarta? 2) How much influence is given by some factors to the travel mode choice in satellite cities in Jakarta? Moreover, 3) How does mode choice impact transportation policy in satellite cities in Jakarta? This research, moreover, attempts to elucidate the impact of the various alternatives on transport policymaking in Jakarta's satellite cities, and it provides evidence on how travel behavior shapes the formation and implementation of transport policies. The study aims to determine the most important parameters, for example, travel time, price, comfort, security, or availability, which make up the general subject matter when choosing public transport. As such, the relative importance will be quantified using the AHP method for factors, which will be weight or priority assigned to the elements. The objective of this study is to contribute by offering valuable insights that will inform the development of an effective transport policy and promote public transportation use in Jakarta's satellite cities. The ultimate goal is to transform a city's transportation system into a sustainable one.

Several studies have previously identified that the socio-demographic characteristics of commuters, such as income, occupation, gender, and period of stay in residence, significantly influence the selection of transportation modes; this underscores the intricate interplay between individual circumstances and transportation decisions. These factors influence travel choices and underscore the importance of tailored approaches considering the preferences and needs of different population segments. Otherwise, commuters' perceptions and actions, such as how much time they spend on the Internet and self-reported social status concerning mode choice, can be linked (Ko et al., 2018). These behavioral differences offer insight into how several types of transportation are perceived and valued by people and highlight the importance of psychological and social aspects according to which people usually decide.

This research will concentrate on the cities directly adjacent to Jakarta, namely Bogor, Depok, Tangerang, and Bekasi, to give a holistic overview of the relationship between the transportation environment and public mode choice in the vicinity of Jakarta. Greater Jakarta is a megacity developed out of the original jam-packing of the Jakarta region as the nation's capital, a city crowded by day and deserted by night (Iskandar et al., 2021). As the dormitory cities of Jakarta, these cities have a large population of commute workers who travel to the capital daily for work, school, and other purposes (Farraz & Barus, 2019).

The paper contributes to the body of literature in the transportation field, particularly for discussions in Indonesia about AHP with public transportation applications. The study's objective is to identify the important factors affecting transport mode choice in the satellite cities of Jakarta and apply the AHP method to weigh them. This research can contribute to developing effective transportation policy and promoting public transportation use, promoting a sustainable and liveable city. Through its focus on transport mode choice and travel behavior, this study will improve our understanding of the factors of travel and mode choice of public transport users in developing megacities such as Jakarta. In addition, this research also offers some practical options for creating sustainable and effective transportation systems in the satellite cities of Jakarta as it divulges the preferences of public transportation users and quantifies the weights of factors affecting their choices.

The study assists decision-makers in prioritizing investments and policies that provide transportation facilities and services by the characteristics of users in meeting the needs of commuters in the satellite cities of Jakarta by identifying the dominant factors that affect the choice of mode and by quantifying their

relative importance. The findings obtained from this study can be used to design community-friendly public transportation services. Thus, ridership is increasing, and congestion in private cars is expected to diminish. In addition, the research results can be used as the basis of participatory urban planning projects, which can help ensure that transportation projects meet public demand and help build more citizen-friendly and environmentally friendly cities (Suryawan et al., 2023).

By analyzing the dynamics of travel mode choice and users' preferences, the research is expected to offer some helpful understanding for policymakers in developing environmentally sustainable and effective transportation systems in Jakarta's satellite cities (Dahlan & Fraszczyk, 2019). The study is anticipated to add to the knowledge of transportation planning. It intends to provide constructive conclusions and recommendations that may aid in developing public transportation services and promoting sustainable urban development (Rosalin et al., 2019).

2. Literature Review

Mode choice theory constitutes a cornerstone of transportation planning, aiming to elucidate individuals' decision-making processes when selecting between various transportation options (Muhtadi & Trisnawan, 2020). This theoretical framework is essential for understanding and predicting travel behavior, particularly in complex urban environments such as Jakarta and its surrounding satellite cities, where many transport modes compete for commuters and other travelers (Nurcahyo et al., 2020). The practical application of mode choice theory necessitates a comprehensive understanding of the factors influencing individuals' decisions, encompassing the intrinsic characteristics of each mode and the broader socioeconomic and demographic context within which these choices are made (Purnomo et al., 2020). These factors typically include travel time, cost, accessibility, comfort, safety, reliability, and personal characteristics such as income, age, car ownership, and residential location (Farda & Lubis, 2018). Given Jakarta's urban transportation landscape, where many daily trips rely on private vehicles, understanding mode choice is critical for promoting sustainable transportation solutions (Siburian et al., 2020).

The selection of transportation modes is intricately linked to each option's perceived utility and overall satisfaction (Basuki et al., 2021). Understanding the nuances of mode choice behavior is particularly pertinent in Jakarta's satellite cities, which experience unique transportation challenges due to rapid urbanization, increasing population densities, and evolving commuting patterns (Farda & Lubis, 2018). The prevalence of private motorized vehicles, particularly motorcycles, in Southeast Asian cities, including Jakarta, highlights the importance of addressing mobility inequalities and promoting more equitable and sustainable transportation options (Hidayati et al., 2019). Addressing traffic congestion requires strategies that account for the social, economic, and demographic constraints specific to Jakarta and similar Southeast Asian cities, ultimately striving for viable and sustainable mobility for all residents (Parikesit & Bambang, 2012). When public transportation does not offer a competitive level of service compared to private vehicles, individuals are less inclined to opt for these modes (Dahlan & Fraszczyk, 2019). The daily influx of Bogor, Depok, Tangerang, and Bekasi commuters into Jakarta contributes to peak-hour congestion, exacerbating road traffic accidents and parking scarcity (Febriani et al., 2020). Understanding these dynamics is crucial for devising effective strategies to promote public transportation usage.

Integrating various public transportation systems is crucial to improving mobility in Jakarta and its satellite cities. Currently, Jakarta has six public transportation modes: MRT, LRT, Airport Railink, KAI Commuter, Transjakarta, and Mikrotrans, that are being integrated into a unified system to enhance the

transportation network and improve the daily lives of urban residents (A'rachman et al., 2022). Mobile phone technology offers additional opportunities for integration with the transportation system, especially since all mobile phones now have GPS functionality, which is expected to improve public transportation convenience in Jakarta and its satellite cities.

2.1 AHP

The AHP provides a strong and flexible tool for the problem of multicriteria decision-making, and it is beneficial when dealing with complex issues with conflicting objectives. AHP decomposes a complex decision problem into a hierarchy so that decision-makers may systematically assess and rank different options according to the relative importance of the procedure and particular specifications. For prioritizing, the decision-makers, at all levels of the hierarchy, make comparisons between a pair of elements; in the considered level I, he determines them as more or less preferred, without specifying a value but the relative importance of one criterion concerning one another directly. Integration process aggregating the individual judgments among them to provide a valuable overall assessment to decide the weights of each criterion and rank the alternative solution. AHP is especially useful in an environment that is subjective and qualitative and in which raw quantitative data would be inadequate to the demands of the entire decision context. Reducing complex decisions to a series of one-on-one comparisons, an approach consistent with human decision-making, made AHP an attractive and accessible tool (Smith & Tighe, 2006).

AHP's capacity to transform intricate decision problems into simpler hierarchical structures is a key strength, accommodating financial and non-financial factors that influence decision alternatives in a structured manner (Gothwal & Saha, 2015). AHP offers a comprehensive framework for selecting the most suitable approach by decomposing complex problems into manageable levels and factors (Hamlat et al., 2021). Adopting AHP in various fields underscores its broad applicability and effectiveness in aiding decision-making processes (Sangiorgio et al., 2021). This approach is designed to capture people's perceptions on a preference scale regarding various alternatives or choices (Timisela et al., 2021). This method is beneficial for enabling individuals to make decisions on complex issues involving many criteria (Corvin et al., 2020). The pairwise comparison process is a cornerstone of the AHP technique, assigning numerical values to represent data and determine the weight of each parameter (Sakmongkoljit et al., 2021).

AHP is a methodology for prioritizing by breaking down a complex problem into a hierarchy (Hamlat et al., 2021). It is a multicriteria decision-making approach to choose the most suitable alternative based on multiple criteria (Hosseini et al., 2015; Lai et al., 2002). An analytic hierarchy process has been widely used in multiple-criteria decision-making problems (Ayağ & özdemidotr, 2007). The elicitation of preferences, typically from experts or decision-makers, is crucial in AHP to ascertain the relative significance of criteria and alternatives under consideration, forming the basis for subsequent prioritization (Кайзер & Neumann, 2021). AHP helps to optimize group decision-making and facilitates a deeper and more accurate understanding of risks, significantly increasing the organization's ability to ensure long-term success (Yazo-Cabuya et al., 2025). Framing the decision, identifying alternatives, modeling the trade study, choosing an alternative, conducting sensitivity analysis, and implementing the selected alternative are the steps of the decision-making process (Wilson, 2008). AHP is a decision-making process that aims to quantify the relevant priorities for a given set of alternatives (Fountzoula & Aravossis, 2022).

Analytical Hierarchy Process-based method allows for identifying and ranking the most significant attributes affecting the choice of mode of traveling in the satellite cities around Jakarta. This methodology allows policymakers to compare different attributes, such as travel time, cost, accessibility, comfort, and environmental impact, to systematically evaluate their choices and select the most effective policy schemes to increase personal travel mode use. Travel time, service reliability, cost, safety and security, comfort and convenience, accessibility, and environmental sustainability are all important considerations influencing people's preferences for their journey options. By synthesizing such key factors, this study can offer helpful information on what type of preferences and priorities are favored by the commuters of Jakarta's satellite cities and how the targeted policies and interventions should be opened to induce a change in user behavior in terms of more sustainable/more efficient transport modes.

AHP is a technique that consistently values points by comparing factors, including efficiency, user comfort, safety, reliability, functionality, and maintainability, with a systematic evaluation (Sangiorgio et al., 2021). With the addition of AHP, the decision-making process will be more transparent, structured, and contextualized geographically in urban areas around Jakarta, thus contributing to realizing a sustainable and effective transportation system. In transportation planning, AHP has been used to quantify the sustainability of various transport solutions systematically, bringing together multiple criteria and stakeholders' preferences (Awasthi & Chauhan, 2011). With the support of AHP, mode choice adopts a multiple factors concept to analyze the transportation mode selection and to facilitate customized strategies encouraging public transportation. The approach accounts for the interest of different stakeholders by evaluating the weights of criteria and the performance of alternatives concerning criteria (Mandić et al., 2021). It is a practical approach that could help decision-makers prioritize objectives and their criteria and find the best alternative.

The Analytic Hierarchy Process is a structured method for organizing and analyzing complex decisions. First, the decision problem is introduced, and the goal is described. Then, the second step is to decompose the problem into a hierarchy of criteria, sub-criteria, and alternatives. Comparison is made among criteria and sub-criteria. These comparisons are then used to generate the weights of individual elements in the hierarchy. The consistency of the pairwise comparisons is verified to get the credibility of the results. The decision makers' or stakeholders' preferences are elicited by pairwise comparisons and synthesized to determine the relative importance of criteria and alternatives. Finally, all the alternatives are scored under the criteria and given a global rating, making it easy to decide. Lastly, combining the weights for the overall ranking of the alternatives that best meet the preferences of the authorities or decision-makers is necessary. The findings of this AHP analysis may facilitate decisions and prioritize resources for better outcomes. The AHP process enables decision-makers to precisely structure the important elements of the problem in a hierarchical manner resembling a family tree.

The AHP method is based on three principles: decomposition, comparative judgment, and synthesis of priorities (Wu et al., 2019). Decomposition involves breaking down a complex decision problem into a hierarchical structure of the goal, criteria, sub-criteria, and alternatives. Comparative judgment involves pairwise comparisons of the elements at each hierarchy level to determine their relative importance. Synthesis of priorities involves aggregating the pairwise comparison judgments to obtain a set of overall priorities for the alternatives. AHP employs a pairwise comparison approach, where each factor is compared against every other factor to determine its relative importance to the decision goal (Wen, 2020). This process results in a comparison matrix that reflects the decision-maker's judgments

regarding the relative importance of each factor (Melvin et al., 2020). These weights are then used to rank the alternatives and identify the most preferred option (Srdjević, 2004). A scale of relative values is derived from all these paired comparisons, and it also belongs to an absolute scale that is invariant under the identity transformation, like the system of real numbers (Saaty, 2016). Pairwise comparisons are performed using a predefined scale, typically 1 to 9, where 1 indicates equal importance and 9 indicates extreme importance.

This hierarchical model is structured to represent the decision problem (top level of the overall goal and the bottom level of criteria, sub-criteria, and alternatives) according to the AHP concept (Romeo & Marcianò, 2014; Saaty, 2004). The values based on this criterion are determined per the color intensity using individual preferences, and then numbers are assigned. This scale enables a more detailed interpretation of determinants affecting mode choice. In AHP, the consistency of the pairwise comparison judgments is determined by a ratio of the consistency. The contradiction in the pairwise comparison judgments may lead to a reduction in the accuracy of the AHP results. In general, a CR of 0.10 or less is good. The weights obtained indicate the relative importance of each criterion that will be considered on public transportation mode choice in the satellite cities of Jakarta (Gao & Li, 2018). The AHP model's outcomes could be applied to the development of public transport policymaking, investment prioritization of public transport infrastructure, and corresponding to the future sustainable and adequate transportation. Because AHP can integrate qualitative and quantitative assessments, it can be used for decision-makers to consider extensive factors that affect the choice of mode.

The use of AHP in transport planning allows decision-makers to consider a set of factors, including cost, time of travel, comfort, and environmental effects. The considerations could be travel time, cost, access, comfort, safety, and environmental impact. The application of AHP enables a logical and transparent comparison of various mode choice alternatives and, thus, facilitates more educated and more defensible decisions. Such an approach enables a better understanding of significant determinants in mode choice decisions and designing targeted measures for promoting public transport modal choice. Applying AHP includes involving the stakeholders in the decision-making process and improving the credibility and acceptance of the results.

3. Methodology

This research applies a quantitative approach with the AHP (Analytic Hierarchy Process) method to identify and determine the priority factors that influence the selection of public transport modes in Jakarta's satellite cities: Depok, Tangerang, Bekasi, and Bogor. AHP was selected because of its capacity to handle complicated multi-criteria problems, and in our case, it involves comparing alternative transportation modes related to several interrelated criteria. The AHP methodology is beneficial because it incorporates the opinions of decision-makers and specialists in the field, offering a perception-based preference scale for various options. The data collection method relies primarily on AHP questionnaires to capture these preferences (Ginanjar & Prajanti, 2021). Respondents are requested to compare the relative importance of preselected factors using a scale of 1 to 9, which reflects the intensity of their preferences (Istianingsih et al., 2022; Timisela et al., 2021). The data acquired will be analyzed to produce a hierarchy of weights that indicate the relative importance of each factor in choosing a mode of transportation (Hamlat et al., 2021).

Mode choice theory is the foundation of transportation planning, which provides a means for analyzing and forecasting how people choose among different transportation modes (Muhtadi & Trisnawan, 2020).

It reveals that travel decisions are not randomly made; instead, they are related to a complicated interaction of influences over a person's comparative evaluation of the utility or attractiveness of the form of travel available to them (Basuki et al., 2021). The mode choice models are typically built on variables such as travel time, cost, accessibility, comfort, safety, and convenience, which are expected to determine the traveler's choice (Langi et al., 2020). Understanding mode choice is important for formulating effective transport policies. It gives planners and decision-makers a mechanism to influence travel demand and encourages a shift towards more sustainable modes (Siburian et al., 2020). Policy implications to encourage preferred modes of transportation are presented based on identifying how travelers consider their transport mode (Ko et al., 2018). Mode choice models are grounded on the assumption that the traveler tries to maximize his/her perceived utility, where utility is defined as the overall satisfaction or benefit of using a mode of transport (Aljohani, 2023). Utility is generally represented by formulas that weigh the relevant factors.

To perform an AHP analysis, a clear decision hierarchy structure is required. This decision hierarchy consists of three primary levels, namely main objective, decision making criteria, and alternatives. For this research the main is to prioritize the most suitable modes of public transportation in Jakarta's satellite cities based on factors that influence user choice.The criteria used in this study are factors that influence transportation mode choice, consisting of 10 factors identified in the literature review, namely: travel cost, travel time, comfort, accessibility, reliability and regularity, social and psychological factors, supporting infrastructure, government policy, economic and social conditions, and also user experience. The transportation mode alternatives considered in this study include public transportation modes available in Jakarta's satellite cities.

When a chosen AHP software reports the results of the numerical process based on user preference data, the various criteria and alternatives are each given a weighting that indicates, relative to the other criteria/alternatives, its importance of influence on the decision-making process. The data is analyzed to determine the dominant factors affecting mode choice by travel in the satellite cities of Jakarta. From these weights, the preferred forms of transport employed will be able to be determined and thus be used to assist in providing transport policies to enhance the public transport network within the specified area.

4. Discussion and Analysis

The AHP model considered comprehensive criteria, not only the traditional economic and operational aspects but also the important factors of social equity and environmental awareness, to balance and evaluate the public transportation modes (Farda & Lubis, 2018). The conclusions of the AHP analysis enable a systematic and strategic allocation of resources and policies that decision-makers can use to plan the development of an integrated and sustainable Jakarta metropolitan transportation. The results of the research lend strong and robust support toward a shift of paradigm to no longer be the current car-oriented transportation system, which is relatively unsustainable due to rapid urbanization, intensifying environmental problems, and the limited capacity of road facilities (Muhtadi & Trisnawan, 2020).

Jakarta has major transportation problems associated with low road capacity and heavy dependency on private cars, where less than one-fourth of trips use public transit (Nurcahyo et al., 2020; Siburian et al., 2020). The level of service of the current public transport system could not compete with private cars in terms of service quality and lack of travel time uncertainty, resulting in continued traffic congestion that impacts the environment, health, and economy (Dahlan & Fraszczyk, 2019). The realization of integrated transportation for Jakarta involving BRT, KRL Commuter Line, and Jakarta Mass Rapid

Transit requires a multi-faceted establishment starting with having the mandate and capacity of a powerful authority of its jurisdiction, formulating an integrated master plan, and supporting from a sustainable resource allocation, funding system, and financing method (Farda & Lubis, 2018).

Travel costs constitute a pivotal factor influencing mode choice within Jakarta's satellite cities, exerting a considerable influence on the accessibility and affordability of various public transportation options for diverse population segments (Purnomo et al., 2020). The economic burden associated with transportation encompasses not only the direct expenses of fares or fuel but also indirect costs such as vehicle maintenance, parking fees, and the imputed value of commuting time (Najid, 2019). Empirical evidence suggests that lower-income commuters are particularly sensitive to travel costs, often prioritizing affordability over other attributes such as travel time or comfort (Tsuroyya & Nuryana, 2021). This sensitivity underscores the importance of implementing equitable fare structures and subsidy programs to ensure that public transportation remains accessible to all residents, regardless of socioeconomic status. The motorization trend in Jakarta has led to increased private vehicle use, disadvantaging marginalized groups who cannot afford private vehicles due to safety risks and inadequate infrastructure for non-motorized traffic (Hidayati et al., 2019). The prioritization of affordable public transportation options is a powerful tool for promoting social inclusion and reducing disparities in access to employment, education, and other essential services across Jakarta's satellite cities.

Travel time emerges as a critical determinant in shaping mode choice preferences among commuters in Jakarta's satellite cities, exerting a significant influence on the perceived utility and attractiveness of various transportation alternatives. In a sprawling metropolitan area characterized by chronic traffic congestion, minimizing travel time is paramount for individuals seeking to optimize their daily schedules and enhance their overall productivity. Commuters are often willing to pay a premium for transportation modes that offer faster and more reliable travel times, particularly during time-sensitive trips such as commuting to work or attending appointments. (Febriani et al., 2020; Sitanggang et al., 2020)

The role of comfort, often overlooked in traditional transportation planning frameworks, is significant in the overall passenger experience and mode choice in Jakarta's satellite cities. Good seats, fresh air, temperature control, and minimum views of other bodies passing through can make public transit more appealing in a long-ish door-to-door. Comfort is often associated by commuters with well-being and relaxation, which can counteract the stress and tiredness experienced during daily travel. Dealing with these different levels of comfort aesthetics can help create more favorable attitudes towards public transport and motivate one private transport mode user to switch to public transport in Jakarta's satellite cities (Kusumawati et al., 2020).

Accessibility constitutes a cornerstone of effective transportation planning, exerting a profound influence on the ability of individuals to access employment opportunities, educational institutions, healthcare facilities, and other essential services within Jakarta's satellite cities. The concept of accessibility encompasses both the physical proximity of transportation infrastructure to residential areas and activity centers and the ease with which individuals can navigate the transportation system, irrespective of their age, mobility, or socioeconomic status. The availability of feeder services influences accessibility, the presence of pedestrian and bicycle infrastructure, and the integration of various transportation modes into a seamless network. Sidewalks, often overlooked, are vital for pedestrian accessibility, yet many areas in Jakarta lack proper infrastructure for comfortable walking (Tanzil &

Gamal, 2021; Arifah & Hidayah, 2021). Improving pedestrian infrastructure around stations is crucial to increase passenger satisfaction (Wardhani et al., 2021).

Reliability and regularity are indispensable attributes of a high-quality public transportation system, substantially influencing mode choice decisions within Jakarta's satellite cities. Commuters place a premium on transportation services that adhere to predictable schedules and operate with minimal disruptions, enabling them to plan their journeys and minimize the risk of delays confidently. Unreliable or irregular service can lead to missed appointments, lost productivity, and increased stress levels, thereby diminishing the attractiveness of public transportation relative to private vehicle use. This can be achieved through investments in infrastructure maintenance, optimized scheduling algorithms, and real-time monitoring systems that enable proactive management of disruptions (Afendi et al., 2020). Improving public transport services includes considering time management and leveraging information technology for better service quality (Nivaan et al., 2021). By prioritizing reliability and regularity, transportation planners can foster greater confidence in public transportation and encourage a modal shift away from private vehicles in Jakarta's satellite cities.

Social and psychological variables, often neglected in conventional travel behavior models, play a subtle but important role in mode choice in the satellite cities of Jakarta, reflecting the intricate relationship between personal attitudes, social norms, and perceived social position. Perceptions of safety, security, comfort, and convenience may influence the preference for commute mode and often have more impact than rational considerations such as cost or travel time. For example, people might choose to use a private car if the person does not feel secure in public transport, particularly at off-peak times or in areas without visible light. On the other hand, some may decide to use public transport as part of their pro-environmental beliefs or to escape judgment from society for being a solo-occupant driver in crowded cities. In addition, social norms and peer influence may all be crucial in determining young workers' transportation choices, with younger workers appearing more likely to imitate the travel behaviors of their friends and associates. On the contrary, some individuals may prefer public transportation to adhere to their pro-environmental attitudes or to reduce the social pressure and anxiety from driving alone on crowded urban roads (Maryatmi & Rahmayani, 2021). Including the psychological variables, for instance, perceived behavioral control, is important in explaining public transit use (Langi et al., 2020). Further, personal values influence public transport use, and these should be encouraged as 'caring for others' (Acker et al., 2021). By recognizing and confronting these social and psychological components, transportation planners may have the opportunity to design more sophisticated, more successful campaigns to encourage residents to embrace mass transit and forsake the use of private autos in the satellite cities of Jakarta. Above and beyond functional utility considerations, psychological factors, such as habits, affective responses to transport modes, symbolic meanings, and perceptions of the need for privacy and autonomy, are also influential in transportation decisions (Murtagh et al., 2012). Transportation choices were motivated by a desire to have control and were shown to be constructed in response to misunderstandings about travel times and underestimation of car-related costs (Gardner & Abraham, 2006).

The supporting infrastructure influences the overall convenience, comfort, and accessibility of different transportation modes and, therefore, affects travel behavior in the satellite cities of Jakarta. Nice, wide, clear roads, parks and rides, and 'walkovers' can make public transport more attractive while reducing car use. Poor infrastructure, including poor road conditions, parking, and inadequate pedestrian and bicycle infrastructure, can lead commuters to use cars instead of public transit. Collateral infrastructure,

like sidewalks, is oft overlooked in pedestrian facilities. This reduces the accessibility to pedestrians. Our culture has favored automobiles over people when building city infrastructure. Furthermore, the connection of different modes of transport to each other through smooth transfers and coordination of schedules also plays a key role in developing a consolidated and efficient transport network. Sidewalks, often neglected, are essential for pedestrian accessibility, but many parts of Jakarta lack a good infrastructure provision for walkable sidewalks (Arifah & Hidayah, 2021). It is necessary to invest in supporting infrastructure to improve the quality and attractiveness of public transportation and stimulate a modal shift from private to more sustainable modes of travel in Jakarta's satellite cities (Ratnawati, 2021). The development of satellite cities can rapidly affect road networks and environmental quality, affecting user satisfaction (Mansyur et al., 2020).

Government policy is a dominant influence on transport modes in Jakarta's satellite cities, and its relative attractiveness stems from a mixture of regulation, funding strategy, and infrastructure provision. Policy measures like congestion fees, limited parking, and partially reimbursed fuel can influence the cost and convenience of private car ownership and use and, therefore, the commuter modal choice behavior (Aulia et al., 2025). On the other hand, public expenditure on public mass transit infrastructure, such as bus rapid transit systems, light rail transit lines, and smart card ticketing systems, can improve the accessibility, affordability, and reliability of public transportation, which will encourage people to shift from private vehicles to public transportation (Rukmana, 2018). The Director General of Land Transportation explains that pedestrians are considered as one of the vehicles in the urban area (Arifah & Hidayah, 2021). Furthermore, policies promoting non-motorized mode use, including providing bicycle lanes and pedestrian areas, may encourage more sustainable travel behaviors. Additionally, linking transportation planning with land use policies is essential for placing new development in locations served effectively by public transit, lessening the need for private vehicle travel. Government intervention through a policy may effectively influence transportation preferences in satellite cities of Jakarta and encourage a sustainable and fair transportation system.

The economic and social conditions of transport significantly influence the choice of transportation amongst Jakarta's satellite cities regarding the affordability, accessibility, and attractiveness of transport modes to different societal groups. Income, employment, and residential density are vital in deciding travelers' accessibility to various transportation alternatives. Public transit may represent the sole alternative for low-income individuals to travel to work or obtain essential services. In contrast, individuals with higher incomes may be able to afford private vehicles (Pallmann et al., 1983). Commuter choices are affected by socio-demographic features. Population growth and over-dimensioned urbanization play an important role in increased mobility, which causes a multitude of transportation problem (Hadi et al., 2018). The lack of affordability and accessibility to suitable transportation systems may result in social exclusion, which is reflected in low density and the scattering of land use, can also exacerbate the problem of transport by increasing trip lengths and reducing the efficiency of public transport. Transportation systems are influenced by land use, spatial segregation, and urban sprawl. In addition, cultural habits and social norms may play a role when choosing between modes of transport, with some people valuing the ease and prestige of owning a private car above all other aspects. In the end, we need to tackle economic and social inequalities that determine how people in Jakarta's satellite cities make transportation choices if we are to build more equitable and sustainable transport systems.

The commute experience involves various factors that affect commuters' perceptions and satisfaction with different transport modes in satellite cities of Jakarta, which is crucial to determining their mode choice. Such factors are travel time, reliability, comfort, safety, and convenience, all of which increase the overall appeal of a mode. For instance, commuters may prefer public transport if it saves time, operates on time, has comfortable seat arrangements, and ensures safety. Contrarily when one mode of public transport is perceived as unreliable, crowded, or unsafe, commuters may choose to take their cars despite its costs and congestion. Hence, negative user experiences can become significant obstacles to employment, education, healthcare, and social participation, perpetuating social inequalities and impairing the quality of life. Hence, knowledge and measures that lead to improvements, especially in user experience, are key to driving the adoption of sustainable modes of travel and, ultimately, life quality for commuters in Jakarta's satellite cities.

Prioritization of public transportation modes in Jakarta satellite cities, as generated by the AHP-based approach, showed a nice ranking of factors affecting mode choice. Some factors have accumulated over other factors. Knowing which derived the highest weight and the associated top-priority factors influence regional transportation decisions is useful. It is important to know what those factors are, which is done in this chapter, in order to develop targeted strategies for sustainable transportation and to address the varying commuting preferences and needs of satellite city commuters within Greater Jakarta. By emphasizing the things that make a difference for commuters, policymakers, and transportation planning, professionals can structure successful interventions to promote transit use that provides fewer traffic jams and a more satisfying overall experience for everyone in the region. Ultimately, such data-driven insights can help guide evidence-based decision-making and establish a more efficient, just, and sustainable transportation system capable of keeping pace with the changing dynamics of Jakarta's satellite cities. The weights with which factors were prioritized emphasize the complexity of the transportation choice process, which has to address many dimensions.

The results of the AHP analysis showed a clear weight comparison and rank as well (Figure 1), against 10 factors influencing the transport mode choice for public purposes in the satellite city of Jakarta. The consistency test results for the analysis using the Analytic Hierarchy Process (AHP) method show a Consistency Ratio (CR) value of 0.03. This value is far below the commonly used consistency tolerance threshold of 0.10. Thus, the pairwise comparison matrix used to determine the weight of the criteria in this study can be said to be logically consistent and valid.The weight of reliability and regularity was the largest, 13.89%, and it was placed as the best. This is unequivocal proof that the most important coincidence for our users is that they always find the service at those times. The weights of comfort and accessibility were also 12.61% and 11.72%, both of which were scored second and third in the item distribution. This means that service quality and accessibility matter in mode choice as well. On the other hand, travel time and supporting infrastructure are weighted about the same at 10.9% each. This points to the need for the quality of service in terms of speed and physical infrastructure of public transport. The weight of the travel cost was 8.43%, and it was ranked seventh. This suggests that while cost is still a significant factor, users place more importance on reliability and comfort within the satellite cities of Jakarta. The following low-weighting factors are Economic and Social Conditions at 7.97%, Government Policies at 7.48%, and User Experience at 6.91%.

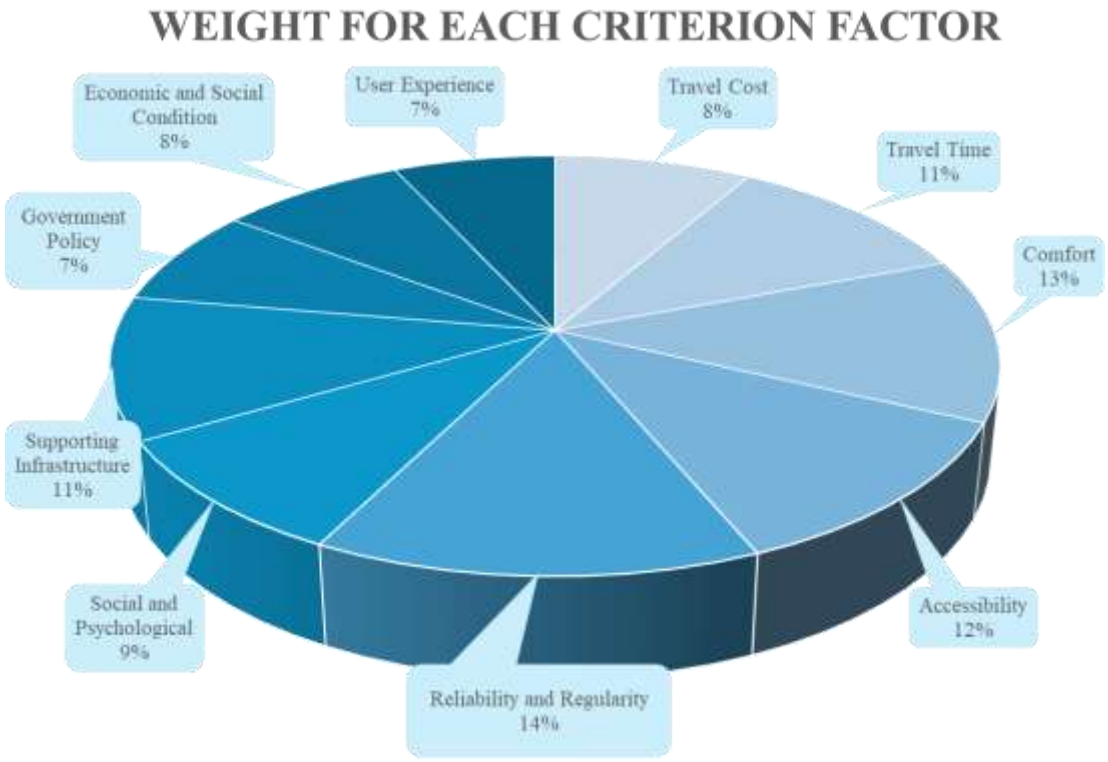

Figure 1. Weight for Each Criterion Factor

The results of the analysis show that reliability and regularity are the factors that affect public transportation use in Jakarta's satellite cities the most. This aspect shows that users will prefer those means of transport, ensuring they are always on time and operating regularly. This is especially the case as satellite cities exhibit high mobility and strongly scheduled daily activities. Lack of certainty of transportation schedule or delays will immediately affect the end users' productivity and quality of life. They must have reliable forms of transportation to the polls. Transportation requirements are fundamental and essential. That reliability is a testament to our transportation management's professionalism and the system's effectiveness. All of these choices are a concern to public trust in transportation. The dimensions of comfort and accessibility also had large weights, which suggest that the users not only focus on such technical issues as time and reliability but also require a transportation mode that can provide them a pleasant and easily accessible journey. The comfort space includes objects, such as the state of a vehicle, cleanliness, temperature, facilities , and supporters during the trip. All these will affect user satisfaction. Because in the satellite cities, people have to walk for many kilometers, comfort plays a significant role in a person's choice of mode. One significant element is the penetrability of different residential areas to the modes of transport. The scope is enormous, and the area of satellite cities is uneven in terms of geography. Accessible forms of transportation, which have recognizable, representative stops or stations and are accessible to persons with disabilities, must enhance the inclusiveness and levels of use of public transport. Travel costs, ranked 7th and less than that of technical and comfort factors. This reflects the fact that in the satellite cities of Jakarta, there would be a preference for caliber and the dependability of transport modes rather than looking for the cheapest fare.

Demand from premium users can be higher than that of standard users, as the latter may tolerate more delays in reducing costs. At the same time, the former is more acceptable to be subjected to potential penalties for additional fees to avoid delay, to enjoy travel convenience, and to arrive punctually for everyday travel, which demands relatively higher punctuality. This trend mirrors the process of urbanization and adjustments in mobility behaviors. The level of public services has also become a more critical part of the competition, especially for labor and students who need effective and reliable accessibility. The more subjective aspects (social, psychology, and experience) that score low in the evaluation indicate that the personal and more subjective factors still belong to secondary aspects in the decision-making of inhabitants of satellite cities. For functional and practical daily mobility, users are more concerned with factual aspects closely related to the effectiveness of their travel. This is not to say that social and psychological factors are unimportant, but they can be grounds for additional qualitative studies on customer perceptions, safety perceptions, and user loyalty. The results indicate that service reliability, comfort, and accessibility should be the primary focus for public transport development plans in satellite cities around Jakarta. Interventions and investments addressing these will increase the attractiveness of public transport modes, decrease the dependence on private motorized modes, reduce congestion, and contribute to more sustainable urban development.

The policy implication of this research is of tremendous consequence for policymakers, transportation planners, and public transportation operators in Jakarta's satellite cities. The findings provide a clear and focused recommendation for enhancements and investments in public transport. The most important three are Reliability and Regularity, Comfort, and Accessibility, which need immediate attention. By investing in systems for real-time monitoring, higher availability rates of the fleet, and better route management, reliability and regularity can be much enhanced. The reliability of transport is meaningful mobility. If buses/tools/trains run when they are supposed to and rarely are held up, then people can plan to use them. Improvements to the comfort of public transportation include modernizing the fleet with air-conditioned buses, comfortable seating, and cleanliness. It is imperative to incorporate universal design principles in infrastructure development, including ramps, elevators, and tactile paving, to ensure accessibility for all users, including the Elderly, individuals with disabilities, and parents with young children. Besides the top three factors mentioned, attention should be paid to safety and security, transfer convenience, information provision, and integration with other modes. This involves developing secure transportation and station security measures, ensuring seamless and convenient mode transfers, available on-demand and accurate information regarding timetables and routes, and easy transition between public transportation with other modes. With travel costs playing a less significant role, policymakers can consider pricing levels that make the trade-off between affordability and the generation of revenues required to fund service enhancement. In addition, at all levels of government, there is a need for institutional arrangements to plan, develop, operate, manage, and coordinate urban transportation systems.

5. Conclusion

Based on the results, the selection of public transportation modes in Jakarta’s satellite cities is most influenced by Reliability and Regularity. This implies that the users are primarily concerned with the timely and consistent nature of service when choosing in this regard. The other two significant aspects are Comfort and Accessibility, which demonstrates that the ease and level of Comfort of the riding experience are the second factors to be considered. The fourth and fifth most important aspects are

Travel Time and Supporting Infrastructure. This means that the time efficiency and availability of facilities such as bus stops and ticket dispensers are important factors. The third most significant aspect, although necessary, is Travel Costs, thus emphasizing the fact that the users are more oriented toward reliability and Comfort than purely economic concerns. Finally, factors such as Social and Psychological Factors affect but do not dominate the decision-making process. The same is true for economic and social conditions, and government policies. The least influential aspect is User Experience, meaning that subjective perception needs to be studied further in this respect. Based on the analysis of the factors, it can be concluded that the appropriate focus for Jakarta's satellite development should be to create a reliable, comfortable, and accessible mode of transportation for each target audience. These results can be a foundation for policymakers and transportation development specialists to build adequate and responsive systems for the local population.

Public transportation policy in Jakarta's satellite cities prioritizes reliable, punctual, and consistent service frequency to ensure user trust, supported by real-time monitoring and adaptive planning. Comfort and accessibility are enhanced through improved infrastructure, such as safe, well-equipped stops and easy electronic ticketing, focusing on people with disabilities and reducing negative environmental and social impacts. Cost management ensures affordability via fair fares and targeted subsidies, balanced with operational sustainability and responsive adjustments. Government plays a crucial role as regulator and facilitator by promoting policy socialization, strengthening agency coordination, and involving the public to build trust and encourage shifts toward an integrated, sustainable, and equitable transit system.

6. Limitations and Suggestions for Further Research

This study has several limitations when interpreting the results and devising future research. Thus, further research should address a larger and more diverse sample, in terms of demography and geography, at multiple sites to get more robust and representative findings of the whole population of transportation users. Furthermore, more subjective matters like usability, user perception, and government policy all need a different research strategy to be better understood. Exploratory analysis of specific individual attitudes, perceptions, and experiences toward the different modes of transportation and how local government policies are understood and experienced in the field represent other qualitative approaches, such as in-depth interviews, focus group discussions, or ethnographic studies. Understanding them more comprehensively will contribute to the establishment of more effective and user-friendly policies. Furthermore, the advancement of information technology in transportation areas can also impact user preference and behavior, which should be further addressed. Further research on this technology will offer valuable tools for modernizing public transportation.

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