

Implementation of the Smart Mobility Concept in the Public Transportation System (Case Study on Transjakarta Services)

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Rapid urbanisasi poses complex challenges in managing the mobility of populations in large cities, especially in transportasi publik. This article examines the implementation of the Smart Mobility concept within the sistem transportasi publik TransJakarta, which is part of efforts to realize a livable, productive, and sustainable city. The study uses a qualitative descriptive approach with observation, documentation, and interviews with active users. The results show that TransJakarta has successfully integrated digital technologies such as e-ticketing, real-time tracking, and the use of environmentally friendly fleets with electric buses. Nevertheless, challenges remain, including uneven distribution of stops and fleets, limited facility quality, issues with infrastruktur TIK, as well as safety and operational management aspects that need improvement. In conclusion, the development of a public transportation system based on Smart Mobility in Jakarta must be supported by sustainable maintenance, integrated technological innovation, driver training, and predictive data management to provide inclusive, safe, responsive, and globally competitive services.

Keywords: Smart Mobility, Transportasi Publik, TransJakarta, Kota Cerdas (Smart City), Infrastruktur TIK, Sustainable Transportation, Technological Innovation, Local and International Accessibility

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1. Introduction

Rapid urbanization in various countries has presented complex challenges for large cities, particularly in managing population mobility. Efficient public transportation is no longer merely an option but has become a fundamental necessity for creating livable, productive, and sustainable cities (Hari & Rahayu, 2019). Therefore, investing in the development of transportation infrastructure and technology is a strategic step to ensure the smooth flow of economic activity and the sustainability of urban social life.

Public transportation plays a crucial role in addressing various classic urban issues such as congestion, air pollution, and unequal access to mobility. A reliable and integrated public transportation system encourages a shift from private vehicles to public transportation. This impact not only increases travel efficiency but also reduces greenhouse gas emissions and improves the quality of life for city residents (Almassawa et al., 2024a). Therefore, developing an efficient, inclusive, and sustainable public transportation system is a strategic step towards a competitive modern urban plan.

As the nation's capital, Jakarta faces a highly complex transportation challenge. This is characterized by the dominance of private vehicles, rapid population growth, and congestion levels that frequently rank among the highest globally (Sitanggang et al., 2018). These conditions demand public transportation innovations that are not only physically massive but also intelligent, adaptive, and user-experience oriented.

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To address these challenges, the Jakarta Provincial Government has adopted the Smart City concept as an information technology-based city management framework. Smart City encompasses six main dimensions, one of which is Smart Mobility, which focuses on developing a safe, efficient, environmentally friendly transportation system that is centered on the needs of city residents (Benevolo et al., 2016). Smart Mobility itself is defined as the integration of digital technology, intelligent data, and information-based services to optimize transportation networks while enhancing user experience (Agni, 2025).

The implementation of the Smart Mobility concept offers various benefits, including the provision of real-time bus location and schedule information, the convenience of cashless payments, and integrated route management. These features are expected to increase service provider accountability, reduce travel time uncertainty, and foster public trust in public transportation (Wirawan, 2020).

In the context of Jakarta, TransJakarta is the Bus Rapid Transit (BRT)-based public transportation system that most consistently implements Smart Mobility principles. Inaugurated on January 15, 2004, by Governor Sutiyoso, this system was the first BRT in Asia designed to provide fast, safe, and affordable services. As it developed, TransJakarta continued to innovate through the implementation of technologies such as electronic payment cards, travel information applications, and an Intelligent Transport System (ITS) for fleet monitoring (Prasetyo et al., 2023).

According to data from PT Transportasi Jakarta (2023), the average daily number of TransJakarta passengers reached over one million, nearly doubling compared to 2019. Currently, the TransJakarta service network encompasses more than 260 routes across 13 main corridors, connecting nearly all areas of DKI Jakarta and its surroundings. This achievement reflects a significant transformation in the technology-based public transportation system and is a milestone in the implementation of Smart Mobility in Indonesia (BPS Jakarta, 2023).

However, despite these achievements, the implementation of Smart Mobility in TransJakarta still faces various challenges that hinder service optimization. In terms of comfort and facility quality, damage to bus stops and air conditioning systems continues to be found, reducing passenger satisfaction. This situation indicates that the indicators of sustainable and innovative transport systems have not been fully achieved, as maintenance systems and service innovation have not been implemented sustainably. Furthermore, frequent passenger overloads during peak hours indicate inefficient fleet distribution. However, with the use of data analysis and digital technology, the fleet management system should be optimized to support the principle of local accessibility, or equitable access to public transportation that is responsive to community needs.

Another frequent issue is bus delays and inaccuracies, indicating a suboptimal GPS-based monitoring and scheduling system. The availability of information technology infrastructure is a key pillar of Smart Mobility, enabling real-time arrival time information to be available to users. Furthermore, accidents involving TransJakarta buses continue to occur, reflecting the need to strengthen safe transport systems through the implementation of safety technology and digital-based driver training. Meanwhile, the planned fare increase due to reduced government subsidies is another crucial issue. Fare increases that are not accompanied by improvements in service quality have the potential to reduce accessibility for lower- and middle-income communities, thus contradicting the principles of local accessibility and sustainable transport systems.

These issues demonstrate the gap between the ideals of a smart transportation system and the reality on the ground. The concept of "smart" should not be measured solely by the presence of digital applications or electronic systems, but also by how people experience the direct benefits of comfort, safety, and efficiency in their daily mobility (Litman, 2015). Therefore, it is crucial to understand how TransJakarta users interpret and experience the implementation of Smart Mobility in their activities.

Based on the above description, it can be concluded that there is a gap between the ideals of technology and the reality on the ground in the implementation of Smart Mobility in Jakarta's public transportation system. Therefore, this research, entitled "Implementation of the Smart Mobility Concept in the Public Transportation System (Case Study of TransJakarta Services)," is relevant.

2. Method

This research uses a qualitative, descriptive approach to describe the phenomena occurring in depth and comprehensively. According to Creswell (2013), qualitative research focuses on understanding the context or phenomena in natural situations and involves interactions between researchers and participants in gathering information. The descriptive approach aims to present information about the conditions or situations being studied and provide a clearer picture of the existing problems (Sugiyono, 2017).

The data in this study were obtained through observation, documentation, and interviews. This data collection aligns with Wardhana (n.d.), who states that in qualitative research, the data collection techniques used must be able to obtain in-depth and comprehensive information about the phenomenon being studied. Observations were conducted to directly observe the activities or processes occurring within TransJakarta services, while documentation was used to study various related archives or records that could support an understanding of the phenomenon.

Interviews were conducted with selected informants, namely Mr. Ferdy and Mrs. Yanti, who regularly use TransJakarta services. The selection of informants was based on certain criteria, such as being active users of the transportation system, having direct experience with accessibility and service quality, and being able to convey information clearly. (Moleong, 2017) stated that selecting informants with in-depth knowledge and relevance to the research topic is crucial for generating valid and credible data.

In addition to primary data obtained from interviews, this study also utilized secondary data sources, such as books, files, government publications, journals, and websites related to public transportation. Relevant books and journals provide in-depth theoretical and empirical perspectives to enrich understanding of the research topic. (Sulung, 2024) stated that secondary data is very useful for complementing and enriching data obtained from the field and providing broader context to the problem being analyzed.

By using this qualitative research method, it is hoped that a more comprehensive understanding of the implementation of integrated transportation systems such as TransJakarta can be achieved, as well as how these services affect accessibility, comfort, and public satisfaction as public transportation users.

3. Results and Discussion

Every government sector in Indonesia urgently needs to support the implementation of the Smart Mobility concept to improve the efficiency of public transportation. Smart Mobility is part of the Smart City concept, developed as an environmentally friendly, high-tech transportation system. The implementation of this concept aims to make public transportation more comfortable, safe, and accessible across all sectors of life. It also encourages people to switch to public transportation. The Jakarta Provincial Government consistently strives to realize a Smart City through one of its dimensions, Smart Mobility. To improve and evaluate public transportation in Jakarta, the Jakarta Provincial Government needs to conduct assessments using a number of indicators compiled based on the characteristics and aspects of Smart Mobility.

Local Accessibility

Local accessibility refers to the ease with which people can access public transportation services from their place of residence or daily activities. In the context of TransJakarta, this aspect includes the availability of bus stops, integration between modes, fare affordability, and speed of service at the local level.

Based on observations and interviews with TransJakarta users, most informants stated that access to main bus stops is relatively easy in central and southern Jakarta, but is still limited in outlying areas such as East and North Jakarta. This aligns with the findings of Rizki & Paramita (2024), who stated that the unequal distribution of TransJakarta bus stops and routes leads to mobility disparities between regions. Although the government has expanded the feeder network and Mikrotrans services, the route and schedule information system is not yet fully optimized, especially for new users.

From a Smart Mobility perspective, ease of local access also depends on digital connectivity and payment system integration. The JakLingko application, which allows users to switch modes (BRT, MRT, LRT, and Mikrotrans) within a single platform, has improved travel time efficiency and reduced travel costs. However, challenges remain regarding the accuracy of fleet position data and delays in real-time information during peak hours, which can degrade the user experience (Rahman et al., 2023).

Efforts to improve local accessibility can be strengthened by developing disability-friendly bus stops, expanding the demand-responsive transport feeder network, and increasing public digital literacy regarding the use of smart mobility applications. This policy direction is consistent with the principles of inclusive urban mobility as recommended by the United Nations-Habitat (2023), which emphasizes the importance of equitable, adaptive, and accessible public transportation for all levels of society.

International Accessibility

International accessibility in the context of Smart Mobility encompasses not only physical connectivity between international regions but also a city's ability to meet global standards for smart and sustainable mobility. TransJakarta, the first BRT system in Asia, is an important representation of Indonesia's efforts to become a world-class city in the public transportation sector.

According to Zhao et al. (2024), international accessibility indicators in Smart Mobility include technological interoperability, cross-system data integration, and participation in global networks such as the Sustainable Urban Transport Index (SUTI). Jakarta has participated in this initiative through the Jakarta Smart City Office, with a focus on digitizing transportation services and improving the energy efficiency of its electric fleet.

Furthermore, international collaboration with institutions such as the Asian Development Bank (ADB) and the World Resources Institute (WRI) has accelerated the adoption of TransJakarta electric buses, with a target of over 2,000 units by 2025 (ADB, 2024). This innovation not only enhances Jakarta's global competitiveness but also contributes to the achievement of Sustainable Development Goal (SDG) 11 on sustainable cities and communities.

Thus, TransJakarta's international accessibility demonstrates a positive direction in connecting Jakarta with sustainable mobility practices globally, although further technical capacity building, transportation data standardization, and cross-border research collaboration are needed to accelerate the digital transformation of Indonesia's public transportation sector.

Availability of ICT Infrastructure

The availability of ICT infrastructure is a determining factor in the successful implementation of smart mobility in TransJakarta services. Systems such as e-ticketing, digital route information, and application integration provide easy access for users and improve operational efficiency. This infrastructure supports

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service speed, transparency, and ease of transfer between transportation modes. This aligns with research indicating that the digitalization of public transportation improves accessibility and service quality and is a key foundation for smart mobility in large cities (Gunawan, 2022).

The use of GPS in the bus fleet, backend servers, and telecommunications networks is a key element in providing real-time data to users. Information such as estimated time of arrival (ETA), route conditions, and bus position can only be optimized if the digital infrastructure is stable. A study on the development of the Transjakarta route application emphasized the importance of integrating GPS and map data to ensure timely and reliable information (Kurniawan, 2021). Other research also indicates that real-time data helps users make faster travel decisions (Herdiana, 2024).

However, the availability of ICT infrastructure remains uneven across all Transjakarta corridors. At some points, GPS sensors, cameras, and data systems still experience delays or missing data. This unevenness impacts the quality of information received by users and impacts travel decisions. A study evaluating smart city services in Jakarta noted that the main obstacle to digital service integration is uneven infrastructure and network quality (Herdiana, 2024).

In addition to technical infrastructure, user readiness also influences the effectiveness of smart mobility. Not all users have the same digital literacy or devices that support application use. Some elderly users or those with limited smartphone access still experience difficulties accessing digital services. Research by Rahmawati (2021) shows that e-ticketing does facilitate transactions, but technology adoption is still influenced by age and habits. Another study emphasized the need for alternative information channels, such as physical information displays, to maintain service inclusivity (Kurniawan, 2021).

To strengthen the availability of ICT infrastructure, network quality improvements, fleet telemetry system updates, and API development that enable integration between transportation modes in Jakarta are needed. Furthermore, improvements to data centers, increased network security, and training of operator human resources are also strategic steps. This is supported by research stating that the sustainability of smart mobility is highly dependent on the readiness of its infrastructure and supporting systems (Margaretha, 2023).

Sustainable, Innovative, and Safe Transport Systems

Sustainable, innovative, and safe transport systems are key pillars in the development of Smart Mobility, as they ensure that public transportation services are not only efficient but also environmentally friendly, adaptable to technological advances, and ensure the safety of their users. In the context of TransJakarta, the implementation of the principles of sustainability, innovation, and safety has shown significant progress, although it still faces a number of structural and operational challenges.

From a sustainability perspective, TransJakarta has strived to reduce carbon emissions by adopting an electric bus fleet. A 2024 report from the Asian Development Bank noted that Jakarta is targeting more than 2,000 electric buses in operation by 2025 as part of its strategy to become a low-emission city. This effort aligns with findings (Almassawa et al., 2024b), which emphasize that the implementation of smart mobility, including the use of environmentally friendly fleets, is a key factor in promoting sustainable transportation in Indonesian cities. The study identified sustainable transportation as being achieved through pollution reduction, energy efficiency, and a modal shift from private vehicles to public transportation. Implementing energy-efficient technology in the BRT fleet is a strategic step in achieving sustainable development goals in the transportation sector.

In terms of innovation, TransJakarta has developed various technology-based systems, such as e-ticketing, real-time tracking, and integration with digital platforms like JakLingko. These digital innovations allow

users to access travel information quickly and accurately. Rahman et al. (2023) emphasized that digital integration plays a crucial role in improving service efficiency and user satisfaction. The use of GPS, fleet monitoring dashboards, and real-time operational data management have helped optimize bus routes and schedules. However, data instability on some corridors indicates the need for comprehensive ICT infrastructure modernization to ensure more consistent information services (Herdiana, 2024).

From a safety perspective, a safe public transportation system is a fundamental requirement for smart mobility. According to Benevolo et al. (2016), smart mobility must improve citizens' quality of life through a transportation system that minimizes risk and is supported by the latest safety technology. TransJakarta uses CCTV, fleet sensors, and technology-based driver control systems to minimize accidents. However, numerous accident reports involving the TransJakarta fleet indicate that driver training and fleet maintenance need to be strengthened. Research by Prasetyo et al. (2023) also confirms that the quality of fleet management, including maintenance systems and safety SOPs, significantly impacts the level of service safety.

Although various innovations have been implemented, the effectiveness of implementing a sustainable and safe transportation system remains heavily influenced by the quality of operational management, facility maintenance, and the ability to adapt to dynamic user needs. Therefore, the development of an intelligent transportation system in Jakarta needs to move towards integrating predictive maintenance, real-time incident reporting, and improving data-driven safety standards. Findings by Herdiana (2024) indicate that improving the quality of digital infrastructure and operational management are key factors in achieving safe and efficient public transportation services in Jakarta. Furthermore, Prasetyo et al. (2023) emphasize that a consistent fleet management system, including routine maintenance and the implementation of safety SOPs, significantly impacts the safety and reliability of transportation services. Therefore, the integration of safety technology and data-driven management is a fundamental element in realizing a truly intelligent and sustainable transportation system. The implementation of Smart Mobility in TransJakarta has shown positive developments, strengthening aspects of sustainability, technological innovation, and operational safety are still needed so that Jakarta can achieve a truly smart and globally competitive public transportation system.

4. Conclusion

The implementation of the Smart Mobility concept in the TransJakarta public transportation system has provided significant progress in improving efficiency, accessibility, and digital technology integration. The implementation of Smart Mobility in TransJakarta has been proven to support ease of local and international access, the development of information technology infrastructure that supports real-time services, and the implementation of an environmentally friendly fleet through electric buses to realize sustainable transportation. However, challenges remain such as uneven distribution of bus stops and fleets, limited quality of facilities, constraints on ICT infrastructure in some corridors, and issues of safety and operational management that need to be strengthened. Therefore, the development of a Smart Mobility-based public transportation system in Jakarta must continue to be improved with a focus on ongoing maintenance, integrated technological innovation, driver training, and predictive data management to make services more responsive, inclusive, safe, and globally competitive. Optimal implementation will support Jakarta's transformation into a modern city that is productive, environmentally friendly, and sustainable.

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