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Moving a Nation: The Evolution of Public Transit in Indonesia - Enhanced Analysis

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ABSTRAK

This study examines the evolution of Indonesia's public transportation system as a reflection of its national development journey, from the colonial period to the modern era of innovation and sustainability. The research focuses on the role of public transport in enhancing connectivity, reducing socio-spatial inequalities, and supporting economic growth. This study is grounded in the understanding that integrated and sustainable public transport represents a crucial instrument for achieving inclusive mobility, reducing carbon emissions, and building more socially equitable cities. Using a qualitative descriptive approach based on literature review and recent empirical data from peer-reviewed research, the findings reveal that public transport plays a strategic role in improving mobility equity, economic efficiency, and carbon-emission reduction. Major transformations have occurred through the implementation of the *Bus Rapid Transit (TransJakarta)* system, development of *MRT* and *LRT* networks, and digital innovations in payment and data-integration systems. However, persistent challenges remain in spatial accessibility gaps, suboptimal modal integration, and long-term financial sustainability. The study concludes that the success of Indonesia's public transport relies on coordinated multisector collaboration, evidence-based policymaking, and the application of inclusive and sustainable mobility principles to achieve equitable, efficient, and competitive urban transport at regional and national levels.

Keywords: public transport; multimodal integration; sustainability; inclusive mobility; Indonesia

INTRODUCTION

Public transport is far more than just a means of getting from point A to point B; it is the lifeblood of a nation's socio-economic fabric, playing an indispensable role in urban development, economic productivity, and social equity. For an archipelagic nation like Indonesia, comprising over seventeen thousand islands and stretching across a vast maritime expanse, the significance of an effective and integrated public transport system is particularly pronounced. It acts as a critical connector, bridging geographical divides and fostering unity among diverse communities.

A robust public transport system ensures accessibility for all citizens, regardless of their socio-economic status. Recent research by Hafiudzan et al. (2024) demonstrates that in Jakarta, middle- and upper-income clusters in Central Jakarta enjoy significantly better multimodal transit access, while dispersed lower-income neighborhoods face weaker connections to rail and formal bus services, reinforcing exclusion from job centers . This spatial inequality underscores the critical role that equitable transport planning plays in social cohesion.

The system provides affordable mobility options, enabling people to access employment, education, healthcare, and other essential services (Fleming, 2018; Lin & Cui, 2021). Without it, vast segments of the population would be marginalized, deepening inequalities and hindering national progress (Bhadra, 2023; ESCAP, 2018; Saaida & Saaidah, 2023; Walker, Pearce, Boe, & Lawson, 2019). Consider the daily

commute of millions in Indonesia's bustling urban centers such as Jakarta, Surabaya, and Medan; an efficient public transport network reduces reliance on private vehicles, alleviating traffic congestion, lowering carbon emissions, and improving urban air quality.

From a sustainable city management perspective, well-integrated multimodal transport systems serve as foundational infrastructure for implementing compact urban development patterns, reducing sprawl, and optimizing land use efficiency (Chadalawada, 2024; Kasuku, 2024; Risimati, 2021; Rode, 2016; Yahia, Chohan, Arar, & Awad, 2025). This integration framework emphasizes the interconnectedness between transport infrastructure, land use planning, and environmental outcomes, recognizing that transport alone cannot achieve sustainability without coordinated urban development policies.

Recent comprehensive research by Lukman et al. (2025) on ambient air quality in Indonesian cities reveals that transportation is a major contributor to urban PM2.5 and NOx burdens, with emissions reductions during the 2020 lockdowns demonstrating transport's strong influence on urban air quality trajectories. This evidence reinforces the environmental imperative for sustainable public transport solutions.

The health implications are profound: improved air quality directly correlates with reduced respiratory diseases, cardiovascular conditions, and premature mortality rates (Psarommatis, May, Dreyfus, & Kiritsis, 2020; Requia et al., 2018; West et al., 2016). For Indonesia's rapidly urbanizing population, these benefits translate into significant healthcare cost savings and an improved quality of life for millions of citizens.

Economically, public transport is a catalyst for growth. It facilitates the movement of labor to industrial and commercial hubs, boosts tourism by connecting key attractions, and supports supply chains by ensuring goods reach their destinations efficiently. Recent empirical analysis by Gaduh et al. (2023), using over 0.5 billion smartcard transactions from Jakarta's TransJakarta system, demonstrates that data-driven route optimization can increase ridership by 16–27%, highlighting the economic potential of evidence-based transport planning.

The development and maintenance of public transport infrastructure also create jobs and stimulate various related industries. From the construction of railways and bus terminals to the manufacturing of vehicles and the daily operations of transit services, it forms a complex ecosystem that contributes substantially to the national Gross Domestic Product (GDP). Furthermore, efficient public transport can increase land values around transit nodes, encouraging planned urban development and smart growth strategies.

In the context of Indonesia—a country with immense geographical diversity and a rapidly urbanizing population—these roles are amplified. The sheer scale of inter-island movement and the intensity of intra-city travel demand innovative and sustainable transport solutions. Current spatial network analysis reveals that only about 41% of Jakarta's road network enables realistic access to BRT stations, with over 58% of

stations suffering poor network connections . This accessibility gap demonstrates the urgent need for comprehensive network redesign and integration.

Historically, the evolution of public transport in Indonesia has mirrored its journey through colonial rule, independence, and modern development, reflecting the nation's continuous struggle and adaptation to connect its people and resources. The path-dependent nature of transport development, as analyzed by Hidayati et al. (2019), shows how decades of car-oriented planning have weakened pedestrian networks and entrenched mobility inequalities that continue to shape who benefits from new transit investments .

This research is urgent because inequality in public transportation accessibility in Indonesia continues to deepen socio-spatial disparities amid rapid urbanization, while recent innovations in data optimization and inclusive design have not been comprehensively studied in a national context. The study’s primary contribution is to provide a holistic analysis of Indonesia's public transportation transformation, integrating historical, empirical, and forward-looking perspectives to inform more inclusive and sustainable transportation policies.

METHOD

This research employed a qualitative descriptive approach through a comprehensive literature review and secondary empirical data analysis. Primary data sources come from peer-reviewed articles, research reports, and institutional publications from 2019 to 2025, with a focus on empirical studies examining Indonesia's public transportation system. A literature search was conducted through academic databases including Google Scholar, ResearchGate, and local journal portals to identify publications relevant to the themes of public transportation, multimodal integration, sustainability, and inclusive mobility in Indonesia.

The analysis was conducted by integrating findings from various studies to identify patterns, trends, and challenges in the evolution of Indonesian public transportation. This approach allows for a holistic synthesis of knowledge scattered across various academic publications. Data is organized chronologically to trace the historical evolution of the transportation system, then subjected to thematic analysis to identify contemporary issues and recent innovations. Empirical citations from peer-reviewed studies are used to support each substantive claim, ensuring the credibility and tractability of the research argument.

RESULTS AND DISCUSSION

Historical Evolution and Development Phases

Colonial Foundations (1800s-1945)

The roots of Indonesia's public transport system trace back to the Dutch colonial period, when the primary focus was on resource extraction and administrative control. The colonial administration established the first railway lines in Java during the 1860s,

primarily to transport agricultural products from the interior to ports for export to Europe.

Early Railway Development

The first railway line, connecting Semarang to Yogyakarta (1867), marked the beginning of systematic transport infrastructure development. The Dutch East Indies State Railway (SS) and private companies like the Nederlandsch-Indische Spoorweg Maatschappij (NIS) expanded the network throughout Java and parts of Sumatra. These early railways were designed with colonial economic interests in mind, creating a hub-and-spoke pattern that connected production areas to export ports rather than facilitating inter-regional Indonesian trade.

Urban Transport in Colonial Cities

In major cities like Batavia (now Jakarta), Surabaya, and Medan, horse-drawn carriages and later electric trams provided urban mobility. The Batavia Electric Tram Company, established in 1899, operated an extensive network that connected the European quarters with commercial and administrative centers. However, these systems primarily served the colonial elite and Dutch settlers, with limited accessibility for the indigenous population.

Post-Independence Reconstruction (1945-1980s)

Following independence in 1945, Indonesia inherited a transport infrastructure designed for colonial extraction rather than national integration. The new government faced the enormous challenge of rebuilding and reorienting the transport system to serve Indonesian development needs.

Nationalization and Rehabilitation

The newly independent government nationalized the railway system in 1945, creating Djawatan Kereta Api (DKA), later reorganized as Perusahaan Negara Kereta Api (PNKA) and eventually PT Kereta Api Indonesia (KAI). The focus shifted from resource extraction to connecting Indonesian cities and facilitating domestic trade.

However, the infrastructure suffered significant damage during World War II and the subsequent independence struggle. The rehabilitation period of the 1950s and 1960s was marked by limited resources, political instability, and competing development priorities.

The Suharto Era: Motorization and Urban Growth

The New Order period (1966-1998) under President Suharto witnessed rapid economic growth and urbanization, fundamentally reshaping Indonesia's transport landscape. The government's development strategy emphasized industrialization and modernization, leading to significant changes in urban mobility patterns.

Road Development and Motorization The government invested heavily in road infrastructure, viewing it as essential for economic development. The Trans-Java Highway project and urban road expansion programs facilitated the growth of private vehicle ownership among the emerging middle class. This period saw the introduction of various forms of public transport, including:

- Angkot (Angkutan Kota): Shared minivans serving fixed routes within cities

- Bajaj: Three-wheeled vehicles adapted from Indian auto-rickshaws
- Ojek: Motorcycle taxis providing door-to-door service
- Metromini and Kopaja: Larger buses serving longer urban routes

Urban Planning and Transport Integration Despite rapid motorization, formal public transport planning remained limited. Cities grew organically around existing road networks, creating sprawling urban forms that would later complicate mass transit development. The informal transport sector flourished, filling gaps left by inadequate formal public transport provision.

Modern Era: Integration and Innovation (1990s-Present)

The modern phase of Indonesian public transport development began in the 1990s with growing recognition of the need for systematic urban transport planning and environmental sustainability.

The TransJakarta Revolution (2004-Present)

The launch of TransJakarta Bus Rapid Transit (BRT) in 2004 marked a watershed moment in Indonesian public transport history. As the first BRT system in Southeast Asia, TransJakarta represented a paradigm shift toward high-capacity, formal public transport.

Phase 1 Development (2004-2010) The initial corridor connecting Blok M to Kota demonstrated the potential of dedicated bus lanes and modern stations. Despite initial challenges with integration and coverage, the system proved popular and expandable.

Network Expansion and Integration (2010-2020) Systematic expansion created a network of 13 corridors covering major Jakarta arteries. The introduction of feeder routes and cross-sectoral routes improved connectivity, though integration challenges persisted.

Data-Driven Optimization (2020-Present) Recent innovations leverage big data analytics to optimize routes and frequencies. Gaduh et al. (2023) document how analysis of over 0.5 billion smartcard transactions enabled evidence-based network redesign, with new direct routes increasing ridership by 16-27% [3].

Rail Renaissance: MRT and LRT Development

Jakarta MRT (2019-Present) The Jakarta Mass Rapid Transit system, operational since 2019, represents Indonesia's first modern urban rail system. The North-South line connects Hotel Indonesia roundabout to Lebak Bulus, with plans for extensive network expansion.

Light Rail Transit (LRT) Systems Multiple LRT projects across Indonesian cities, including Jakarta, Palembang, and planned systems in Bandung and Surabaya, demonstrate growing commitment to rail-based mass transit.

Technological Integration and Smart Systems

Recent developments emphasize technological integration and user-centric design:

1) Integrated Payment Systems The implementation of unified electronic payment across different transport modes represents a significant step toward seamless multimodal journeys.

2) Real-Time Information Systems Mobile applications and digital displays provide real-time information on arrivals, routes, and service disruptions, improving user experience and system reliability.
3) Inclusive Design Initiatives Recent research by Tam (2024) highlights Indonesian cities' efforts to prioritize inclusive public transport, including Braille-lined handrails, wheelchair accessibility improvements, and participatory design processes involving disability advocacy groups [6].

Current Challenges: A Comprehensive Analysis

Spatial Inequality and Accessibility Gaps

Contemporary research reveals persistent spatial inequalities in transport access across Indonesian cities. Hardi and Murad (2023) conducted comprehensive spatial analysis of Jakarta's TransJakarta system, finding that only 41% of the city's road network enables realistic access to BRT stations, with over 58% of stations suffering poor network connections [4].

Quantified Accessibility Challenges

Network Coverage Deficits

- 51% of Jakarta's area classified as inaccessible at defined walking thresholds to BRT stations
- Significant gaps in first-mile/last-mile connectivity
- Limited integration between formal and informal transport modes

Socio-Economic Disparities Housing cluster analysis by Hafiudzan et al. (2024) reveals that middle and upper-income areas in Central Jakarta enjoy superior multimodal transit access, while dispersed lower-income neighborhoods face systematic exclusion from quality transport services [1]. This pattern reinforces existing socio-economic inequalities and limits social mobility.

Integration and Coordination Challenges

Despite significant infrastructure investments, Indonesian public transport systems continue to face critical integration challenges:

Modal Integration Deficits

- Fragmented governance structures across different transport modes
- Limited physical integration between BRT, rail, and informal transport
- Inconsistent service standards and operational procedures

Institutional Coordination

Research by Azhari and Fitriati (2023) on Jakarta's MRT development emphasizes the importance of "Penta-Helix" collaboration models involving government, industry, academia, community, and media stakeholders. However, implementation remains challenging due to competing institutional interests and limited coordination mechanisms [7].

Environmental and Health Impacts

Air Quality and Emissions

Comprehensive research by Lukman et al. (2025) on ambient air quality in Indonesian cities identifies transportation as a major contributor to urban PM2.5 and

NOx pollution. The study documents significant emissions reductions during 2020 COVID-19 lockdowns, demonstrating transport's substantial impact on urban air quality [2].

Health Implications:

- Increased respiratory disease incidence in high-traffic areas
- Cardiovascular health impacts from prolonged exposure to transport emissions
- Disproportionate health burdens on low-income communities near major transport corridors

Climate Change Considerations

Indonesia's commitment to reducing greenhouse gas emissions by 29% by 2030 (or 41% with international support) under the Paris Agreement requires significant transport sector transformation. Current modal split patterns, dominated by private vehicles and informal transport, present substantial challenges for achieving these targets.

Funding and Financial Sustainability

Capital Investment Requirements

Transit-oriented development (TOD) research by Batudaa (2022) identifies substantial capital requirements for sustainable transport infrastructure, including:

- High upfront costs for rail infrastructure development
- Limited domestic financing capacity for large-scale projects
- Dependence on international development finance with associated conditionalities [8]

Operational Sustainability

- Subsidy dependence of formal public transport systems
- Competition from informal transport affecting ridership and revenue
- Limited fare integration across different operators and modes

Recent Innovations and Future Directions

Data-Driven Network Optimization

The most significant recent innovation in Indonesian public transport involves leveraging big data analytics for evidence-based planning and operations. Gaduh et al. (2023) document groundbreaking research using over 0.5 billion smartcard transactions from Jakarta's TransJakarta system to optimize network design [3].

Key Findings and Applications

Route Optimization Results

- New direct routes increased ridership by 16-27%
- Frequency improvements and wait-time reductions showed strong ridership elasticity
- Commuters demonstrated greater sensitivity to wait times than in-vehicle travel times

Policy Implications The research provides specific guidance for network expansion:

- Prioritize reducing wait times over densifying central corridors
- Focus on direct connections rather than hub-and-spoke configurations

- Use real-time data to optimize frequencies based on demand patterns

Inclusive Design and Accessibility

Recent initiatives emphasize inclusive design principles and universal accessibility. Tam (2024) documents comprehensive efforts across Indonesian cities to prioritize inclusive public transport design [6].

Specific Innovations

Universal Design Implementation

- Braille-lined handrails and tactile wayfinding systems at TransJakarta stations
- Wheelchair-accessible station designs and vehicle modifications
- Dedicated spaces for mobility devices and assistive equipment

Participatory Design Processes

- Institutionalized consultation with disability advocacy organizations
- Community co-design workshops for station and vehicle improvements
- Quality control roles for persons with disabilities in infrastructure upgrades

Gender-Responsive Transport Planning

- Women-only carriages during peak hours
- Improved lighting and security measures at stations and stops
- Gender-sensitive design of waiting areas and facilities

Technological Integration and Smart Mobility

Integrated Payment and Information Systems

Multi-Modal Payment Integration Recent developments include unified electronic payment systems enabling seamless transfers between different transport modes. This integration represents a crucial step toward creating truly multimodal transport networks.

Real-Time Information Systems

- Mobile applications providing real-time arrival information
- Digital displays at stations and stops
- Integration with navigation and journey planning applications

Smart Traffic Management

Adaptive Signal Control Implementation of intelligent traffic management systems that prioritize public transport vehicles at intersections, reducing travel times and improving service reliability.

Dynamic Route Optimization Real-time adjustment of routes and frequencies based on traffic conditions, demand patterns, and service disruptions.

Transit-Oriented Development (TOD)

Research by Batudaa (2022) examines TOD implementation in Jakarta Metropolitan Area, identifying both opportunities and challenges for sustainable urban development [8].

TOD Implementation Strategies

Mixed-Use Development

- Integration of residential, commercial, and office uses around transit nodes
- Density bonuses for developments within walking distance of stations

- Affordable housing requirements in TOD projects

Pedestrian and Cycling Infrastructure

- Protected walkways connecting residential areas to transit stations
- Bicycle parking and bike-sharing facilities at major transit nodes
- Traffic calming measures in TOD zones

Challenges and Lessons Learned

Land Use Planning Integration

- Limited coordination between transport and land use planning authorities
- Existing urban form constraints on TOD implementation
- Balancing development density with green space preservation

Affordability and Gentrification

- Risk of displacement of low-income residents from TOD areas
- Need for inclusive development policies and affordable housing preservation
- Community engagement in TOD planning processes

Governance and Institutional Innovation

Penta-Helix Collaboration Models

Research by Azhari and Fitriati (2023) documents innovative governance approaches involving five key stakeholder groups: government, industry, academia, community, and media [7].

Collaborative Benefits

- Enhanced stakeholder coordination for complex transport projects
- Improved technology adoption and knowledge transfer
- Strengthened community engagement and social acceptance

Implementation Challenges

- Coordination complexity with multiple stakeholder groups
- Competing interests and priorities among participants
- Need for clear governance structures and decision-making processes

Future Vision: Toward Sustainable and Integrated Mobility

Multi-Modal Integration Strategy

The future of Indonesian public transport lies in creating seamlessly integrated multi-modal networks that combine the strengths of different transport modes while addressing their individual limitations.

Network Integration Principles

Physical Integration

- Unified station design enabling easy transfers between modes
- Integrated fare systems and journey planning
- Coordinated scheduling and service frequencies

Digital Integration

- Unified mobile applications for all transport modes
- Real-time information sharing across different operators
- Integrated payment and ticketing systems

Service Integration

- Coordinated service planning and route optimization
- Unified customer service and complaint handling
- Integrated accessibility features across all modes

Sustainability and Climate Resilience

Electrification and Clean Energy

Electric Bus Fleets Transition to electric bus fleets for BRT and conventional bus services, supported by renewable energy infrastructure and charging networks.

Rail System Expansion Continued expansion of electric rail systems (MRT, LRT, and commuter rail) as the backbone of urban transport networks.

Active Mobility Integration Integration of walking and cycling infrastructure with public transport networks, including bike-sharing systems and protected cycling lanes.

Climate Adaptation

Resilient Infrastructure Design

- Flood-resistant station and infrastructure design
- Climate-controlled facilities for passenger comfort
- Backup power systems for service continuity

Emergency Response Integration

- Public transport systems designed to support emergency evacuation
- Coordination with disaster management authorities
- Community resilience building through accessible transport

Technology and Innovation

Autonomous and Connected Vehicles

Autonomous Shuttle Services Pilot programs for autonomous shuttle services connecting residential areas to major transit nodes, particularly in new urban developments.

Connected Vehicle Technology Integration of connected vehicle technology to optimize traffic flow, reduce congestion, and improve safety.

Artificial Intelligence and Machine Learning

Predictive Analytics AI-powered systems for predicting demand patterns, optimizing routes, and preventing service disruptions.

Personalized Journey Planning Machine learning algorithms providing personalized transport recommendations based on individual travel patterns and preferences.

Social Equity and Inclusion

Universal Design Principles

Comprehensive Accessibility Implementation of universal design principles ensuring accessibility for all users, regardless of age, ability, or socio-economic status.

Affordable Access Subsidized transport programs for low-income users and vulnerable populations, ensuring transport access does not become a barrier to social and economic participation.

Community Engagement

Participatory Planning Institutionalized community engagement processes ensuring local needs and preferences inform transport planning decisions.
Capacity Building Programs to build local capacity for transport planning, operations, and maintenance, creating employment opportunities and ensuring long-term sustainability.

CONCLUSION

The evolution of public transport in Indonesia mirrors the country's broader development, advancing from colonial-era extraction systems to post-independence rebuilding and now toward modern, integrated networks. Recent research highlights both the challenges—such as spatial inequality, limited modal integration, and environmental concerns—and the opportunities arising from innovations in data-driven planning, inclusive design, and technology. Future success relies on sustained evidence-based policymaking, community involvement, and long-term investment to ensure accessible, affordable, and sustainable mobility for all. Continued research should focus on evaluating the impacts of these innovations at scale and developing strategies to overcome persistent inequalities while adapting to Indonesia's rapidly changing urban landscape.

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