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Prioritizing Service Management Improvement Strategies for Bus Rapid Transit: An Analytic Hierarchy Process Approach in Transjakarta

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Abstract

This study examines service management priorities for Transjakarta using operational data from 2004–2021 and reported Analytic Hierarchy Process (AHP) judgements from nine experts. The hierarchy covers factors, actors, objectives, strategies, sub-strategies, targets, and sub-targets. By September 2021, the fleet comprised 4,208 buses, including 3,308 (78.6%) operated by partners under a payment-per-kilometre arrangement. Annual ridership increased from 102.3 million in 2015 to 264.7 million in 2019, then declined by 50.1% in 2020. The reported priorities identify policy as the main factor, Transjakarta management as the principal actor, and integrated service improvement as the main objective. Safety is the leading strategy, safety training the leading sub-strategy, and reliability the leading target. Safety and security at ticket counters, waiting areas, and bus stops constitute the leading sub-target. These results support coordinated safety standards, driver training, and more reliable scheduling across operators. However, the available results do not include comparison matrices, numerical priority weights, consistency ratios, or sensitivity tests. The findings therefore describe reported expert priorities rather than independently reproducible rankings or evidence of intervention effectiveness. Their application requires updated operational data and validation of the underlying AHP calculations.

Keywords: Analytic Hierarchy Process; Bus Rapid Transit; Safety; Service Management Strategy; Operator Partnership; Transjakarta

INTRODUCTION

Transjakarta, a bus rapid transit (BRT) system, grew from a single 12.9 km corridor when it began operating in 2004 (Ernst, 2005) to a 251.2 km network with

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260 bus stops and 13 corridors during the study period (Simanullang et al., 2022). The fleet increased from 91 buses in 2004 to 4,222 in 2020. Ridership rose from 102.3 million in 2015 to 264.7 million in 2019 before declining during the pandemic.

The expansion took place through operator partnerships. In September 2021, Transjakarta itself managed 900 of the 4,208 buses; partners operated 3,308 buses under a payment-per-kilometre arrangement. Partnerships allow services to expand with private investment (Hook, 2005), but they require oversight so that operators' interests remain aligned with safety and service reliability (Canitez et al., 2019). The enforcement of penalties for standard violations also depends on the institutional capacity of the authority (Gómez-Lobo & Briones, 2014).

Passenger complaints cover waiting times, delays, crowding during peak hours, arrival information, and driver behaviour. A survey of 260 passengers reported a relationship between service quality and satisfaction and loyalty (Simanullang et al., 2022). These findings provide a reason to link network expansion with improvements in daily operations.

Limited resources require priorities to be set among route development, fleet maintenance, safety, finance, and human resources (HR). AHP is widely used to structure multi-criteria transport decisions (Yannis et al., 2020; Moslem et al., 2023). This article links management factors and actors to service strategies and targets, complementing studies of Transjakarta policy (Devi et al., 2021) and driver safety behaviour (Mardi Safitri et al., 2020).

This study aims to describe the development of Transjakarta's operations and partnership framework in 2004–2021 and to outline strategy priorities based on the judgements of nine experts. The article focuses on management and policy; the passenger survey findings of the related study have been reported by Simanullang et al. (2022).

LITERATURE REVIEW

Strategic Planning in Public Transport Service Management

Strategic planning sets an organisation's objectives and its priorities for allocating resources (Olsen, 2007). In public transport, network planning, vehicle and crew scheduling, and operational control are interrelated (Ibarra-Rojas et al., 2015). Waiting-time standards, for example, affect fleet requirements and the passenger experience.

BRT Governance and Operator Partnerships

BRT can support route reform, service standards, and operator investment (Hook, 2005). Under gross-cost contracts, the authority receives fare revenue and

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pays operators according to the service provided, for example operating kilometres. This scheme reduces competition for passengers but requires performance oversight (Sheng & Meng, 2020). Experiences in Latin America and Istanbul underline the importance of authority capacity and of aligning operator incentives with service quality (Gómez-Lobo & Briones, 2014; Canitez et al., 2019).

Safety and Driver Behaviour

Driving risk increases when task demands exceed the driver's capability, including as a result of fatigue (Fuller, 2005). Safety culture, pay, and organisational scheduling are also associated with risky behaviour (Mokarami et al., 2019; Wang et al., 2022). Among 391 Transjakarta drivers, safety climate was related to safety motivation and knowledge as well as to driver violations (Mardi Safitri et al., 2020). Training needs to be positioned alongside supervision, technology, and infrastructure improvements within a safety management system (Godfrey et al., 2018).

AHP in Transport Decision-Making

AHP structures decisions into a hierarchy and uses pairwise comparisons to calculate relative priorities (Saaty, 1990, 2008). Its applications include sustainable planning, differences in stakeholder preferences, and Indonesian transport policy (Hamurcu & Eren, 2020; Ghorbanzadeh et al., 2018; Kresnanto et al., 2022). The review by Moslem et al. (2023) summarises its use in transport; Jou et al. (2023) applied it to the evaluation of bus services. The credibility of rankings depends on the reporting of weights, consistency, and aggregation procedures.

RESEARCH METHODS

Approach and Data Sources

This descriptive study combines fleet data (2004–2021), passenger data (2015–2021), a review of partnership regulations, and the AHP priorities of nine experts. The operational data were processed in 2021; the regulations covered include DKI Jakarta Governor Regulation (Pergub) No. 103 of 2007, No. 96 of 2018, and No. 11 of 2019.

Experts

Nine experts provided pairwise comparison judgements. They were selected purposively on the basis of the relevance of their expertise and experience, not to represent a population statistically (Saaty, 2008). The available documents do not detail each expert's profile, affiliation, years of experience, or the timing of the

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assessment; this limitation reduces the ability to assess the representativeness of perspectives and the potential for selection bias.

Hierarchy Structure

The focus of the hierarchy is the strategy for improving Transjakarta service management. The seven levels beneath it cover factors, actors, objectives, strategies, sub-strategies, targets, and sub-targets. The five strategies and their details are presented in Table 1.

Table 1. Strategies and sub-strategies for improving the Transjakarta service management system

Strategy	Sub-strategies
Operational	Compliance with operational standard operating procedures (SOPs); routine fleet maintenance inspections; fleet integration; quality monitoring
Safety	Safety training; alcohol- and drug-free drivers; compliance with safety SOPs; accident cause research; safety management system
Financial	Investor governance; internal and external audits; improved financial management
Human resources	Recruitment and selection; training and development; orientation and placement; value building; lean organisational structure; performance appraisal (promotion/demotion); HR planning
Public relations and marketing	Continuous communication; public outreach

Source: Processed data (2021)

The targets cover the five SERVQUAL dimensions (Parasuraman et al., 1988) plus sustainability. Table 2 retains the source classification; the placement of bus renewal under responsiveness and of cleanliness under empathy requires construct validation.

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Table 2. Targets and sub-targets

Target	Sub-targets
Tangibles	Additional routes; improved facilities; additional fleet; provision of mobile ambulances
Reliability	Fulfilment of service promises; travel itineraries; good administration; waiting-time standards; scheduling for peak and off-peak hours
Responsiveness	Bus renewal; ease of submitting complaints; maintenance tracking
Assurance	Driver competency certification; safety and security (ticket counters, bus waiting areas, and bus stops); minimum standards for limiting passenger numbers
Empathy	Staff friendliness and courtesy; cleanliness of buses, ticket counter areas, and waiting areas; staff readiness
Sustainability	Relations with investors; incentives/dividends for investors; driver and staff remuneration

Source: Processed data (2021)

Analysis Procedure

AHP uses pairwise comparisons on a 1–9 scale and reciprocal matrices, $a_{ij} = 1/a_{ji}$. Weights can be calculated through the principal eigenvector. Consistency is assessed using CI = (λmax − n)/(n − 1) and CR = CI/RI, where n is the matrix size and RI is the random index. The customary evaluation threshold is CR ≤ 0.10 (Saaty, 1990, 2008). Group judgements can be aggregated using the geometric mean (Forman & Peniwati, 1998). The source document does not provide the matrices, the

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actual aggregation procedure, the weights, or the CR values. The article reports the source priorities without claiming verification of the calculations.

RESULTS

Fleet Development

Figure 1 summarises the growth of the fleet from 91 buses in 2004 to 4,222 in 2020. Expansion accelerated after 2013: from 1,325 buses in 2014 to 3,865 in 2019, an increase of 191.7%. In September 2021, the fleet totalled 4,208 buses. The annual figures provide context on the scale of operations; they are not a direct measure of service quality.

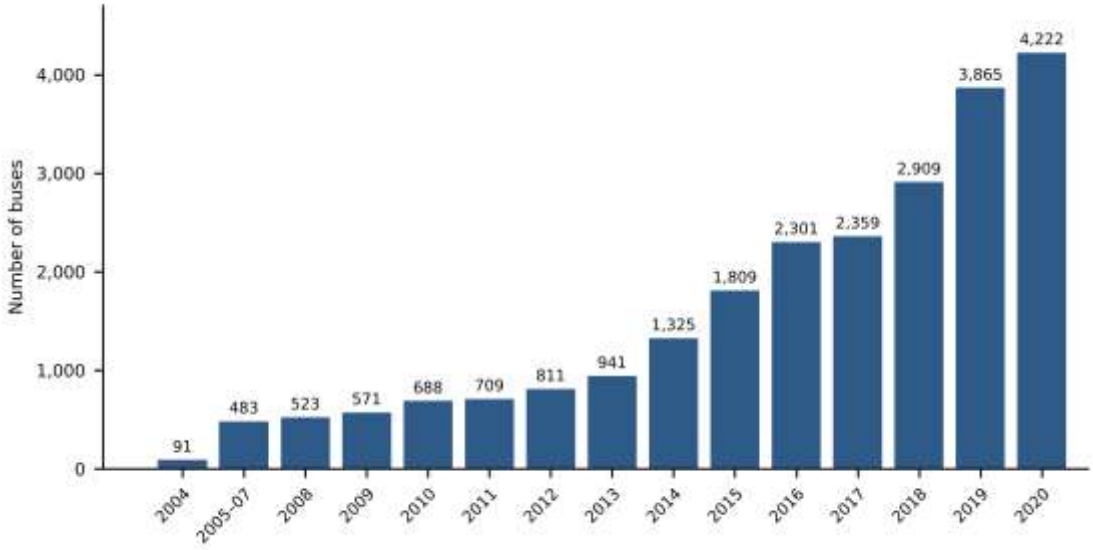


Figure 1. Development of the Transjakarta fleet size, 2004–2020

Source: Processed data (2021). The 2005–2007 figure is the fleet size for that period.

In September 2021, the self-managed fleet totalled 900 buses (21.4%) and the partner fleet 3,308 buses (78.6%). Partners include private operators and state-owned enterprises. The large share of the partner fleet underlines the need for standard coordination and oversight across operators.

Passenger Development

Table 3 and Figure 2 show the rise in ridership from 102.29 million in 2015 to 264.70 million in 2019: growth of 158.8%, or about 26.8% per year compounded. Ridership fell by 50.1% to 132.16 million in 2020. The figure of 87.21 million for 2021

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covers only January–September and is not directly comparable with the annual totals.

Table 3. Passengers, fleet size, and passengers-per-bus ratios, 2015–2021

Year	Number of passengers	Change (%)	Fleet size	Passengers per bus per year	Passengers per bus per day
2015	102,290,384	–	1,809	56,545	155
2016	123,706,857	+20.9	2,301	53,762	147
2017	144,867,779	+17.1	2,359	61,411	168
2018	188,983,488	+30.5	2,909	64,965	178
2019	264,703,712	+40.1	3,865	68,487	188
2020	132,160,074	−50.1	4,222	31,303	86
2021 (Jan–Sep)	87,206,507	–	4,208	–	–

Source: Processed data (2021); passengers-per-bus ratios were calculated by the authors from passenger and fleet numbers. The 2021 figure covers only nine months and is therefore not compared with the previous year.

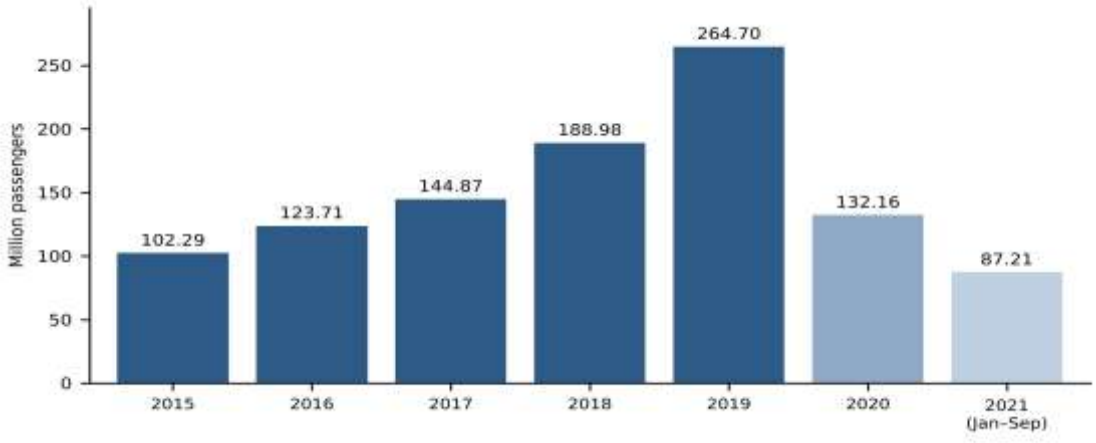


Figure 2. Transjakarta ridership, 2015–2021

Source: Processed data (2021)

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The aggregate ratio of passengers per bus per day rose from about 155 in 2015 to 188 in 2019, then fell to 86 in 2020. The calculation uses the total recorded fleet and 365 days as an approximation. This ratio does not measure load factors, the number of buses active each day, or peak-hour crowding because data on bus-kilometres, capacity, and time distribution are not available.

Regulatory Framework of the Partnership Model

The partnership framework during the study period comprises DKI Jakarta Governor Regulation (Pergub) No. 103 of 2007 on the Macro Transportation Pattern, Governor Regulation No. 96 of 2018 on the Integration of Feeder Transport into the Bus Rapid Transit System, and its amendment through Governor Regulation No. 11 of 2019. The analysis of the source documents links integration to payment for services per kilometre and to the obligation to follow SOPs and minimum service standards (SPM). This discussion is historical in nature and does not state the regulations' validity status at the time of publication.

AHP Results

Table 4 and Figure 3 summarise the reported top-priority elements. This presentation does not include the magnitude of the weights, the differences between alternatives, or the uncertainty of the rankings. The leading sub-target falls under the assurance dimension; the figure does not establish a single global path or a causal relationship.

Table 4. Top-priority elements at each hierarchy level

Hierarchy level	Top-priority element
Factor	Policy
Actor	Transjakarta bus management
Objective	Integrated service improvement
Strategy	Safety
Sub-strategy	Safety training
Target	Reliability
Sub-target	Safety and security at ticket counters, bus waiting areas, and bus stops

Source: Processed data (2021)

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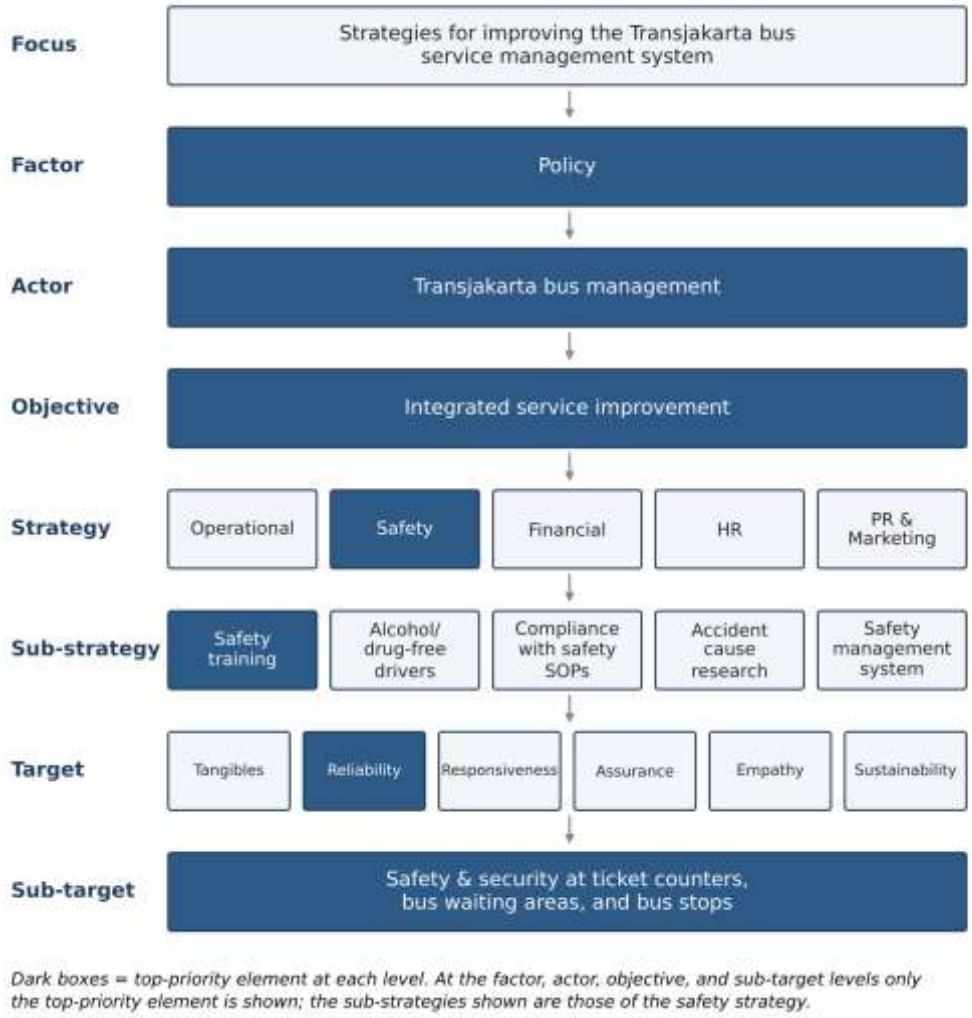


Figure 3. AHP hierarchy structure and summary of the reported priorities at each level

The experts placed policy, Transjakarta management, and integrated service improvement as the priorities at the factor, actor, and objective levels. Safety became the leading strategy and safety training the leading sub-strategy. Reliability leads the target level, while safety and security at ticket counters, waiting areas, and bus stops lead the sub-target level.

DISCUSSION

Why Safety Is the Top Priority

The safety priority reflects the experts' concern about the risk of injury, operational disruption, and loss of passenger trust. Fuller's (2005) framework

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explains the relevance of task demands and driver condition. However, this study does not use accident data to test the causes or the effectiveness of safety strategies.

With 78.6% of the fleet operated by partners, uniformity of oversight becomes a system management issue. A study of Transjakarta drivers links safety climate to motivation, knowledge, and violations (Mardi Safitri et al., 2020). Cross-context findings on organisational culture and company management support attention to drivers' working conditions (Mokarami et al., 2019; Wang et al., 2022), without establishing the magnitude of their impact in this study.

Reliability and a Sense of Safety as Service Targets

Reliability covers the fulfilment of service promises, waiting times, and schedules for peak and off-peak hours. The passenger complaints reported in Simanullang et al. (2022) support the relevance of this target. The rise in the passenger-to-fleet ratio provides demand context but does not establish a decline in punctuality or a capacity shortage on particular corridors.

The sub-target of safety and security at ticket counters, waiting areas, and bus stops extends attention from the journey to access to the service. In the hierarchy, this sub-target falls under assurance. The passenger literature links perceptions of safety and security with loyalty (Nguyen-Phuoc et al., 2021), while Jou et al. (2023) include safety in the evaluation of bus service quality. The relationship between safety and satisfaction is also discussed by van Lierop et al. (2018).

Policy as the Leading Factor and Management as the Leading Actor

The policy priority directs attention to contract design and oversight. The bus contracting literature emphasises service incentives and authority capacity (Sheng & Meng, 2020; Gómez-Lobo & Briones, 2014). Under payment per kilometre, safety and reliability indicators deserve to be evaluated together with service volume. The results do not establish that policy constrains service quality more than fleet capacity does; the findings indicate the emphasis of the expert group. The study by Devi et al. (2021) provides context on the relationship between policy and Transjakarta's performance.

Implementation Roadmap

Policy strengthening: review SOP and SPM indicators for waiting times, capacity, safety, and driver readiness. Evaluate the linkage between payment and performance on the basis of auditable data and contract provisions. Capacity strengthening: design recurrent training, competency assessment, fatigue

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management, and incident investigation for all operators. Health checks and alcohol and drug testing require protocols that are lawful, proportionate, and protect drivers' confidentiality. Improving reliability and security: align schedules with demand, strengthen security at bus stops, and integrate passenger information and complaint channels. Monitor waiting times, schedule adherence, and incidents per bus-kilometre before and after interventions.

POLICY IMPLICATIONS, LIMITATIONS, AND RECOMMENDATIONS

Policy Implications

For regional governments and Transjakarta management, the reported priorities support evaluating safety standards across operators, strengthening training, and monitoring reliability. Fleet growth still needs to be assessed together with demand and service coverage. Linking operator incentives to quality is a policy option that needs to be tested, not a causal conclusion from this AHP.

Limitations and Recommendations for Further Research

The matrices, local and global weights, CR values, and sensitivity tests are not available, so the rankings cannot be replicated. The expert profiles and the construction of the hierarchy are also not detailed; the classification of several sub-targets requires validation. The data end in September 2021, and the fleet ratios use recorded buses rather than active buses. Further research needs to complete the AHP records, update the data, involve operators and passengers, and test sensitivity across groups (Ghorbanzadeh et al., 2018). The Analytic Network Process could be considered for dependencies among criteria. The effectiveness of the strategies requires intervention evaluation.

CONCLUSION

The reported priorities of the nine experts place safety as the leading strategy, training as the leading sub-strategy, and reliability as the leading target. Safety at facilities is the leading sub-target under the assurance dimension. The findings support evaluating cross-operator standards and scheduling in the context of the 2004–2021 data. Without weights and consistency diagnostics, applying the results requires validation of the calculations and updated data.

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