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Green and Clean Mobility: A Study of Trans Batam's Management and Administration in Supporting Sustainable Transportation

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Abstract: This study aims to comprehensively analyze how Trans Batam's infrastructure management contributes to the principles of Green & Clean Mobility, a public transportation concept focused on efficiency, quality and public access. The research focuses on three main management aspects: (1) facility suitability; (2) governance mechanisms and operational management; and (3) sustainability principles.The analysis was conducted using an exploratory quantitative approach, assessing each research dimension with SmartPLS 4.3.0.1. One hundred respondents participated during the research period and expressed their willingness to volunteer to support the research. The results indicate a significant correlation between each exogenous and endogenous dimension. They are integral to driving the quality of Trans Batam's transportation services. Furthermore, this is supported by an R^2 value of 67.2% (0.672). This demonstrates that the involvement of the research dimensions does contribute to improving Trans Batam's public transportation services. Furthermore, the Q^2 value of 0.485 indicates strong predictive relevance, indicating that the model not only explains variation within the sample but also has adequate predictive capacity. Ultimately, this research can serve as policy recommendations and contribute to the development of an inclusive, efficient and sustainable public transportation service model—Trans Batam.

Keyword: Public Transportation, Sustainability, Management, Governance

INTRODUCTION

Urban mobility faces increasingly complex challenges with increasing urbanization, the intensity of economic activity and citizen demands for fast, safe and comfortable travel. In many cities, the policy debate shifts between two approaches: capacity expansion as a solution and mobility system transformation through strengthening sustainable public transportation. Empirical evidence from Papadakis and Toledano shows that improving the quality of public transportation, specifically urban bus services, more consistently reduces dependence on private vehicles when accompanied by improvements in access, comfort and service integration (Papadakis et al., 2024; Toledano et al., 2025).

In line with this statement, the concept of Green & Clean Mobility is relevant because it positions public transportation not merely as a means of transportation but also as an instrument for improving environmental quality, energy efficiency and accessibility. However, a crucial debate exists regarding the green dimension through technological innovation and the implications of sustainability schemes, which are determined by behavioral changes and systemic governance (Elassy et al., 2024). In this regard, both seek to integrate public transportation into a robust, substantive technical and operational dimension (Gergis, 2024).

At the operational level, the sustainability of public transportation services is determined not only by schedules and routes, but also by the quality and management of facilities that support the user experience. Fleet facilities, bus stops, safety facilities, information systems and maintenance and facility management mechanisms. The debate that arises is whether increasing ridership is more effectively achieved through operational improvements or through improvements in facilities and information. A study by Rivera-Coloma et al (2025) shows that both are mutually reinforcing: good operations are complex to appreciate when facilities are uncomfortable and unsafe, while good facilities are not optimal without service reliability . However, in developing countries-Indonesia, integrating the two is difficult due to a low level of mindset and a complex governance structure. Therefore, it impacts the user experience, operational effectiveness and the service's ability to support environmental sustainability.

On the other hand, there is debate about how transportation sustainability should be measured and implemented. Oktavianti et al (2025) and Pojani & Stead (2015) emphasize that sustainability aspects must be assessed based on systemic efficiency—including energy efficiency, mobility patterns and modal integration. Meanwhile, Geerlings & Stead (2003) highlight an environmental governance approach, which is considered more important than simply technical indicators. In this context, Trans Batam, as a public transportation system, requires management that not only meets operational needs but also addresses long-term sustainability demands that impact the environment and urban spatial planning.

Another crucial aspect is how sustainability is measured and decided. Therefore, the debate over the use of indicators as objective tools to guide priorities also presents a dilemma, as it is politically charged and is often interpreted to justify specific policy directions (Bücher, 2025; Tibrani et al., 2024). Therefore, measuring Green & Clean Mobility requires caution so that technical indicators do not override public service dimensions such as accessibility, safety and reliability, which ultimately determine public adoption.

Although numerous studies on sustainable transportation and the quality of public transportation services have been conducted in Indonesia, most studies have focused on user satisfaction, fleet operational performance, or the evaluation of general transportation sector policies. Meanwhile, studies specifically addressing facility management as the foundation for green and clean mobility remain very limited. In the context of Trans Batam, a public transportation system, the issue of infrastructure management becomes increasingly crucial. Findings indicate declining quality, a fleet approaching advanced operational age and inadequate supporting facilities, such as route information and accessibility for vulnerable groups (Lodan et al., 2023). This situation indicates that Trans Batam's quality does not yet meet the principles of environmentally friendly mobility. At the same time, the implemented facility management policies have not been systematically oriented towards the Green & Clean Mobility agenda.

In the Indonesian context, studies of public transportation and urban bus services place infrastructure as an integral part of service quality and user perceptions. Research in Jakarta by Nursasi & Yenita (2023) demonstrated a relationship between service quality and perceived accessibility and safety. However, debate arises perception findings are often not linked to overlapping asset management mechanisms (Saif et al., 2018), accountability schemes and the enforcement of service standards and consistent monitoring (Hasibuan & Mulyani, 2022).

In the Batam context, studies on the performance of public transportation services—buses—emphasize the importance of infrastructure, such as the suitability and condition of bus stops and other support, as prerequisites for reducing private vehicle use (Khairina et al., 2025; Paselle et al., 2024). However, academic criticism has been that recommendations often stop at the normative level, necessitating a more nuanced understanding of governance. Qualitative studies of public transportation infrastructure asset management in other cases in Indonesia also demonstrate that the relationship between asset management and service quality is a governance issue, not merely a technical one (Putera et al., 2025).

Based on the literature review, the research gap lies in the limited number of studies that place management as the direct foundation for achieving green and clean mobility in the context of city buses, particularly in the case of Trans Batam in Batam. The novelty emphasized is the integration of three often-separated domains: the physical feasibility of infrastructure; governance mechanisms and operational management; and efforts to implement sustainability principles (the sustainable mobility paradigm). With this framework, research is crucial not only for assessing conditions but also for demonstrating the managerial pathways that ensure infrastructure truly supports long-term, clean, efficient and usable public transportation. The research framework is shown in Figure 1 and the research indicator variables are shown in Table 1.

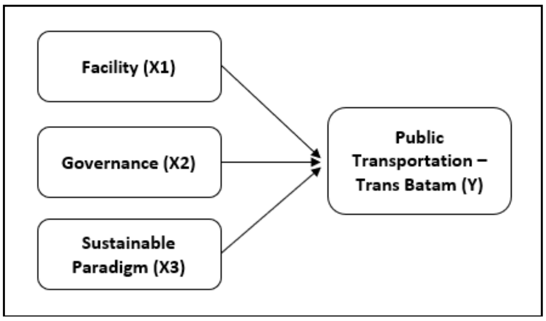

Figure 1. Research Framework

Table 1. Research Variable and Indicator

Construct	Operational	Indicator
Facility (X1)	Respondents' perceptions of the availability, adequacy and functionality of physical public transportation infrastructure that supports ease and comfort of use.	X1.1 Bus Stop Suitability
		X1.2 Fleet Comfort
		X1.3 Facilities Cleanliness
		X1.4 Physical Accessibility
		X1.5 Physical Safety Features
		X1.6 Information Facilities
Governance (X2)	Respondents' perceptions of service governance quality: clarity of regulations, consistency of supervision, maintenance, responsiveness and coordination of services and accountability.	X2.1 Clarity of Service Standards/SOPs
		X2.2 Planned Maintenance
		X2.3 Monitoring & Evaluation
		X2.4 Response to Complaints/Griefs
		X2.5 Management Coordination
		X2.6 Transparency & Accountability
Sustainable Paradigm (X3)	Respondents' perceptions of green and clean mobility orientation in service policies and practices: cleanliness, efficiency, environmental awareness and inclusiveness as service development values.	X3.1 Green Commitment
		X3.2 Operational Efficiency
		X3.3 Clean Service Environment
		X3.4 Inclusiveness & Equity of Access
		X3.5 Integration of Sustainable Mobility
		X3.6 Continuous Improvement
		Y1.1 Reliability/Accuracy

Construct	Operational	Indicator
Public Transportation – Trans Batam (Y)	Respondents' perceptions of public transportation service performance/quality as outcomes: reliability, safety, comfort, ease of access/information and user satisfaction.	Y1.2 Coverage & Ease of Use
		Y1.3 Travel Safety & Security
		Y1.4 Convenience of Travel Experience
		Y1.5 Clarity of Service Information
		Y1.6 Satisfaction & Intention to Use

This gap becomes even more relevant in the context of Batam City, which is rapidly developing as an industrial area and regional hub with a high population density. Batam's characteristics require a more integrated and sustainable model for managing public transportation infrastructure. However, few studies have comprehensively examined how facility management and the quality of Trans Batam contribute to achieving sustainable transportation.

Building on this debate, this study positions Trans Batam as a key case study due to its role as the backbone of urban mobility while simultaneously addressing infrastructure challenges. Studies on Trans Batam services have addressed bus stop conditions, schedule information and facility maintenance. However, these are presented as parts of the service that have not been explicitly discussed as core management for sustainable mobility.

The novelty of this research lies in its effort to integrate the perspectives of sustainable transport, infrastructure-asset management and public service governance for Green & Clean Mobility as a sustainable public transportation management practice. The research gap addressed is the limited number of studies explaining how condition management, maintenance, arrangement, facility standards and information support contribute to green and clean principles in urban bus services, particularly in the Batam context.

Therefore, this research aims to analyze the physical feasibility of infrastructure, governance and operational management mechanisms and efforts to apply sustainability principles (the sustainable mobility paradigm) in the management of Trans Batam as a foundation for recommendations for inclusive, safe, efficient and environmentally friendly public transportation. This research is expected to provide theoretical contributions to the development of transportation studies and practical contributions to the local government and Trans Batam managers in formulating effective and efficient facility management strategies and supporting a sustainable urban public transportation system.

METHOD

This study uses a quantitative-exploratory design with a cross-sectional approach to map the condition and performance of Trans Batam's management in supporting Green & Clean Mobility principles. This exploratory approach was chosen because the study not only assesses the quality of service but also identifies the dimensions of infrastructure management that most influence perceptions of feasibility, comfort and sustainability. Indicator-based measurement is essential for measurable recommendations; however, technical indicators can be biased if not linked to user experience and governance practices. Therefore, this study incorporates user and stakeholder assessments as the basis for priority mapping.

The unit of analysis is the components of the Trans Batam bus service that directly impact users and operations, including the fleet, bus stops, safety features, travel information and maintenance mechanisms. The measurement framework is structured into three research dimensions representing Green & Clean Mobility practices: the physical feasibility of infrastructure (X1); governance and operational management (X2); and efforts to implement sustainability principles (sustainable mobility paradigm) (X3) toward the future of public transportation in Batam (Y). The formulation of these dimensions maintains a balance between green sustainability indicators (efficiency, environmental impact) and service-critical public service indicators (access, safety, reliability).

Primary data was collected through a survey using a 1–5 Likert-scale questionnaire (1=strongly disagree, 5=strongly agree). The 100 respondents included service users, operational staff and relevant stakeholders, ensuring that the mapping was not solely based on user perceptions but also took into account management realities. Purposive-accidental sampling was used at service points to capture respondents who had actually experienced the service, meeting the minimum criteria of having used Trans Batam between October 2025 and January 2026. An exploratory study strategy was appropriate to obtain a transparent picture of respondents' reporting and to state its limitations explicitly.

Data analysis was conducted in stages using SMARTPLS 4.3.1.1. First, an outer model statistic was used to map each indicator's condition and generate a composite score for each dimension (Hair et al., 2014). Second, an inner model test was conducted to ensure the consistency of the dimension items (Sarstedt et al., 2021). Third, as part of the construct structure exploration, the study used Exploratory Factor Analysis (EFA) to determine whether the empirical item groupings were consistent with the theoretical framework and to ensure that the indicator structure of each construct (X1–X3–Y) was within the appropriate components. This stage positions the analysis not as a causal test, but rather as a validation of prominent dimensional patterns in the Trans Batam context. Fourth, for policy recommendations, the mapping results are prioritized for improvement.

Furthermore, PLS-SEM testing aimed to test the significance of the regression by examining the influence of each exogenous construct on the endogenous construct (Y). The research results are measurable and remain aligned with the literature debate on the importance of integrating technical indicators of user experience into the sustainable mobility agenda.

RESULTS AND DISCUSSION

The outer model serves as the initial stage for reliably and validly testing the relationships between constructs. Each assessment indicator is evaluated to demonstrate the path of inherence within the research construct. First, indicator reliability is evaluated through outer loadings with a threshold value of >0.70. Indicators with loadings below the threshold are considered methodologically and their removal is evaluated to determine whether it improves the construct's quality without altering its conceptual meaning. Second, internal consistency reliability is assessed using Composite Reliability (CR) with a threshold of >0.70 ; thus, strong reliability indicates its influence and suitability for the research construct.

Third, convergent validity is evaluated using Average Variance Extracted (AVE) with a criterion of >0.50, indicating that the construct explains more than half of the variance in its indicators. If the AVE does not meet the threshold, the indicator with the lowest loading is reviewed, while ensuring that statistical decisions do not compromise the construct's theoretical definition. Fourth, discriminant validity ensures that each construct is empirically distinct from the others. The overall results are presented in Tables 2, 3 and 4.

The outer model evaluation stage aims to ensure that constructs (X1), (X2), (X3) and (Y) are adequately measured by their indicators before interpreting structural relationships. In the reflective model, the primary focus includes indicator reliability, construct internal consistency, convergent validity and initial collinearity checks to ensure stable estimates. In terms of indicator reliability, all outer loadings ranged from 0.742 to 0.842. This range indicates that each indicator makes a substantial contribution to reflecting its construct, as PLS-SEM generally considers loadings >0.708 to be an adequate threshold to ensure a reasonable proportion of the indicator's variance is explained by the construct [29].

Viewed per construct, the outer loading range for (X1) was 0.748 to 0.829; (X2) was 0.757 to 0.832; (X3) had an outer loading range of 0.742–0.815; and (Y) had a loading value range of 0.765–0.842. This means that no single indicator dominates; instead, all indicators fall within a relatively uniform range, resulting in a more balanced and unbiased representation of the construct.

The strength of these indicators is also reinforced by the significant t-statistics, ranging from 14.08 to 20.34, with p-values of 0.000 for all indicators. Substantively, the indicator-construct is not merely a sample but serves to anchor the construct being measured, providing a more defensible measurement basis for further analysis.

Furthermore, the indicators show no signs of disruptive collinearity. VIF values range from 1.96–2.78, which is still far below pathological collinearity and screening bias of standard methods based on full collinearity. In other words, there is no apparent overlap between indicators that could destabilize the estimates.

Table 2. Outer Loading Result

Construct	Indicator	Outer Loading	t-stat	p-value	VIF
Facility (X1)	X1.1	0.781	16.84	0.000	2.11
	X1.2	0.812	18.27	0.000	2.36
	X1.3	0.764	15.92	0.000	2.08
	X1.4	0.829	19.41	0.000	2.44
	X1.5	0.793	17.55	0.000	2.29
	X1.6	0.748	14.63	0.000	1.98
Governance (X2)	X2.1	0.804	17.90	0.000	2.58
	X2.2	0.832	19.76	0.000	2.71
	X2.3	0.791	16.84	0.000	2.33
	X2.4	0.776	15.48	0.000	2.19
	X2.5	0.819	18.62	0.000	2.66
	X2.6	0.757	14.92	0.000	2.05
Sustainable Paradigm (X3)	X3.1	0.769	15.61	0.000	2.14
	X3.2	0.742	14.08	0.000	1.96
	X3.3	0.801	17.42	0.000	2.38
	X3.4	0.786	16.31	0.000	2.24
	X3.5	0.758	14.77	0.000	2.07
	X3.6	0.815	18.10	0.000	2.49
Public Transportation (Y)	Y1	0.813	18.05	0.000	2.52
	Y2	0.776	15.94	0.000	2.18
	Y3	0.842	20.34	0.000	2.78
	Y4	0.801	17.26	0.000	2.45
	Y5	0.792	16.63	0.000	2.31
	Y6	0.765	14.88	0.000	2.09

In terms of convergent validity, all constructs met the requirements, with AVEs ranging from 0.600 to 0.660. On average, the constructs explained approximately 60% or more of the variance in their indicators—a measure of solid measurement quality. The highest AVE was found for Y (0.660), followed by X2 (0.650), X1 (0.630) and X3 (0.600); all of which exceeded the general threshold of AVE ≥0.50.

These results indicate strong, consistent and stable measurement: valid indicators, no collinearity, high construct reliability and convergent validity. With this foundation, the research results are well-positioned to proceed to discriminant validity and then to interpret the inner model fully.

Table 3. Construct Reliability & Convergent Validity

Construct	Cronbach's Alpha	rho_A	Composite Reliability (CR)	AVE
Facility (X1)	0.872	0.878	0.903	0.630
Governance (X2)	0.889	0.894	0.916	0.650
Sustainable Paradigm (X3)	0.861	0.867	0.896	0.600
Public Transportation (Y)	0.894	0.899	0.919	0.660

Table 4. Discriminant Validity-Fornell lacker Criterion

Construct	X1	X2	X3	Y
Facility (X1)	0.794	0.580	0.550	0.700

Governance (X2)	0.580	0.806	0.620	0.740
Sustainable Paradigm (X3)	0.550	0.620	0.775	0.650
Public Transportation (Y)	0.700	0.740	0.650	0.812

Table 4 displays the results of the Fornell–Larcker discriminant validity test. The results indicate that all constructs have adequate conceptual separation. This is evident from the diagonal values (square root of AVE), which are consistently higher than the construct's correlations with other constructs: X1=0.794, X2=0.806, X3=0.775 and Y=0.812. Thus, each construct is more effective at explaining the variance of its own indicators than at sharing variance with other constructs, thereby preventing excessive conceptual overlap in the measurement model.

On the other hand, although the correlation values for X2 with Y (0.740) and X1 with Y (0.700) are relatively high, this is substantively reasonable, as the quality of public transportation services is related to governance and facilities. Both remain below the average AVE of each construct, so these constructs remain identified as distinct entities. Overall, these results confirm that the model meets the requirements for discriminant validity and warrants proceeding to inner model interpretation.

After the measurement model (outer model) meets the requirements for reliability and validity, the analysis proceeds to the inner model to assess the strength and direction of the relationships among constructs within the research framework. At this stage, the primary focus is: (i) ensuring there is no multicollinearity in the predictors (through the inner VIF), (ii) testing the significance and direction of the influence of X1, X2 and X3 on Y using bootstrapping (path coefficient/β, t-stat, p-value and 95% CI) and (iii) evaluating model power through R^2 and predictive relevance through Q^2. Thus, the inner model interpretation not only answers "significant" but also demonstrates the substantive contribution of the constructs through F^2 and the model's ability to explain the outcome.

Table 5. Inner Model Result

	Path (β/O)	Mean (M)	STDEV	t-stat	p-value	95% CI (2.5%)	95% CI (97.5%)	F^2
X1>Y	0.312	0.305	0.058	5.379	0.000	0.198	0.422	0.128
X2>Y	0.421	0.418	0.061	6.902	0.000	0.302	0.540	0.214
X3>Y	0.186	0.190	0.052	3.577	0.000	0.086	0.288	0.061

The inner model results in Table 5 show that all three exogenous constructs have a positive and significant effect on (Y). The effect of (X1) has a coefficient of β=0.312 with a t=5.379 and p=0.000 and a 95% CI in the range of 0.198–0.422 that does not cross zero. This indicates that improvements in facility quality are followed by improvements in service performance assessments, with a substantive contribution at a small–moderate level (F^2=0.128).

The effect of (X2) on Y is the dominant predictor with β=0.421, t=6.902, p=0.000 and a CI of 0.302–0.540; the effect size is medium (F^2=0.214), thus empirically, governance consistency of standards, responsiveness, monitoring and coordination are determinants of service performance variation. Meanwhile, (X3) on Y is statistically significant (β=0.186; t=3.577; p=0.000; CI 0.086–0.288), with a relatively small contribution (F^2=0.061), which implies that sustainability orientation plays a reinforcing role, but its direct influence is not as large as the facilities and governance aspects in explaining service assessment.

Table 6. Structural Model Result

Endogen	R^2	R^2 Adjusted	Q	SRMR	
Y	0.672	0.661	0.485	0.062	Strong explanatory power, good predictive relevance

Finally, the performance of the structural model in Table 6 demonstrates strong explanatory power. The R^2 value of 0.672 (adjusted R^2 of 0.661) indicates that 67.2% of the variation in Y is explained simultaneously by X1, X2 and X3, thus the model has substantive explanatory power for the context of this study. The Q^2 value of 0.485 confirms good predictive relevance, meaning the model not only explains variation in the sample but also has adequate predictive capacity. Meanwhile, the SRMR of 0.062 is within the range generally considered appropriate to indicate adequate model fit, so the overall results support the conclusion that strengthening governance and facilities are the main pillars of Trans Batam service improvement, with the sustainability paradigm as a supporting factor that remains significant but has a more limited effect size.

This discussion positions Trans Batam as an arena for interaction between facility quality, governance capacity and sustainability orientation in shaping user experience and system performance. Transportation literature emphasizes that public service quality does not stand on a single dimension, but rather is built on a combination of reliability, safety, comfort, information availability and ease of access (Tuan et al., 2022). However, debate arises when service improvement approaches show positive results in increasing passenger numbers; this is indeed closely correlated linearly because user response is also influenced by the context of congestion, mobility habits and perceptions of travel time relative to private vehicles (Pojani & Stead, 2015; Rahmadani & Manggalaou, 2025).

In aspect X1, the findings support Banister & Lodan's argument that fleet quality and operation, bus stop comfort, information legibility and cleanliness all function as service professionalism and reduce travel friction (Banister, 2008; Lodan et al., 2023). In bus service quality studies, seemingly simple attributes become leverage points because users and influencers directly perceive them and can influence assessments of the entire system. However, Rutka criticized the infrastructure-first bias, arguing that facility investments can yield marginal benefits if travel times and network connectivity are not yet competitive, thus preventing physical improvements from automatically driving a stable modal shift (Rutka et al., 2024).

Dimension X2 is interpreted as the institutional engine that translates facilities into service consistency. Contractual and benchmarking perspectives on public transportation services indicate that customer-perceived quality is primarily determined by governance design: service standards, accountability mechanisms, performance indicator setting, quality control and the operator-regulator's ability to manage complaints and iterative improvements. In the Indonesian context, studies of public transportation services highlight that satisfaction issues extend beyond fleets to headway certainty, integration and consistent policy implementation (Khairina et al., 2025; Paselle et al., 2024). However, the debate is that procedural governance can create rigidity, slow field response and foster administrative compliance without improving the user experience. Therefore, effective governance demands a balance between control and operational agility.

In X3, a stronger interpretation is to view sustainability as a policy orientation that ties service decisions to environmental goals, energy efficiency, inclusiveness and urban quality of life, rather than simply a normative label. The sustainable mobility paradigm critiques conventional transportation planning, which solely pursues travel cost minimization and emphasizes the need for changes in socio-institutional conditions for sustainable transportation policies to materialize (Filippi, 2022; Russo, 2022). However, the sustainability framework is difficult to operationalize at the daily service level when organizations face budget constraints, pressure to meet short-term demand and public resistance to restrictions on private vehicles.

Interestingly, the relationship between the constructs can be understood as complementary: good facilities increase the visibility of quality, governance ensures service reliability and discipline. At the same time, the sustainability paradigm provides a guiding direction. In line with Tuan's argument, service quality improvement is most effective when supported by a policy prioritization strategy that selects service factors most likely to influence satisfaction, as improvement resources are always limited. On the other hand, Sogbe argues that prioritization based on user perceptions can overlook long-term strategic factors such as energy transition and emission reductions, which are invisible to users in the short term, thus requiring strong governance justification and policy communication (Sogbe et al., 2025; Tibrani et al., 2023).

From a performance-based contracting perspective, quality assurance also emerges when operators are guided by measurable, periodically evaluated service indicators, ensuring improvements are not ad hoc but follow an auditable performance cycle. Consequently, a deeper understanding of Trans Batam's quality is possible if governance is understood as a tool that maintains service reliability over time, rather than merely as policy administration (Hensher, 2015).

On the other hand, the sustainable mobility framework emphasizes that sustainability is not a conceptual add-on but a lens for assessing public transportation services, moving beyond the logic of cost minimization to broader objectives—such as inclusion, safety, quality and policy legitimacy. Therefore, the sustainability paradigm should be read as an orientation that guides program priorities, while also opening up space for debate when long-term goals clash with short-term performance pressures. This is relevant, as service dimensions such as accessibility and safety are important determinants of user perceptions. Therefore, a sustainability agenda will be more effective if it is translated into tangible and measurable service attributes.

Implications for Batam include a policy direction that extends beyond physical projects to governance-based improvements: strengthening service standards, transparent monitoring mechanisms and rapid improvement cycles based on complaints/incidents, while maintaining a sustainability agenda that is present in route, headway and integration decisions. Lessons learned from the BRT context in Indonesia also show that customer satisfaction correlates with consistent service quality, not simply program rollout. However, debate remains, as emphasizing control can undermine service innovation. Therefore, an adaptive governance model tends to be more resilient to the dynamics of urban mobility needs.

In terms of scientific contribution, this discussion strengthens the position of urban public transportation research, which views transportation quality as a product of institutional factors and prioritizes equitable, inclusive policies. Evidence from urban planning also confirms that practical attributes often determine competition with private vehicles, so improvement agendas must be directed at tangible user experiences while remaining anchored in a vision of sustainability. At the same time, critics of the linear approach remind us that changing mobility behavior requires consistency, policy legitimacy and integrated interventions; and they also reinforce the relevance of governance and sustainable paradigm constructs in research outcome models.

CONCLUSION

This study assesses how X1, X2 and X3 shape the performance of Trans Batam's public transportation services as an endogenous variable (Y) using a quantitative-exploratory PLS-SEM approach. The analysis provides a clear picture of the primary sources of leverage for service improvement and demonstrates that the model quality meets the requirements for drawing reliable conclusions.

Substantively, the findings indicate that service governance is the factor with the most significant contribution to driving service performance (β=0.42; F^2=0.21). This means that consistent operational standards, quality control, responsiveness to complaints and internal coordination are more important determinants of service quality than temporary improvements. Furthermore, facilities also a significant role (β=0.31; F^2=0.13), indicating that bus stop conditions, comfort, accessibility, cleanliness and information remain prerequisites for a user experience. Meanwhile, the sustainability paradigm also provides a significant boost (β=0.19; F^2=0.06), though its contribution is minor. This suggests that the sustainability agenda needs to be translated into concrete operational practices for a more tangible impact on service performance assessments.

In terms of modeling quality, the findings demonstrate conditions that convincingly support structural interpretation. The predictors show no disturbing collinearity (inner VIFs are within a safe range), so the estimated influence of each variable can be interpreted as a relatively independent contribution. The model's explanatory power is also relatively strong, with an R^2 of around 0.67 (approximately two-thirds of the variation in Y can be explained by X1–X3) and a Q^2 of 0.49, indicating good predictive relevance. The model's fit is adequate (SRMR around 0.06), so the model structure can serve as a framework for data-driven evaluation and decision-making.

Practical implications: Prioritize improvements sequentially. First, strengthening governance through clear performance indicators, routine data-based monitoring, documented complaint handling mechanisms and disciplined maintenance coordination. Second, directing facility investments toward aspects most closely related to user experience—access, safety, comfort information—and ensuring consistent maintenance to prevent rapid decline in quality. Third, position the sustainable paradigm as the mainstream of operational policies (service integration, inclusiveness and efficiency) so that sustainability is not limited to narratives but becomes a work parameter that can be evaluated.

This research still has limitations, particularly the potential for differences in perceptions across corridors and the lack of objective operational indicators for comparison. Further studies are recommended to expand the scope across corridors, combine perception data with operational data and examine intermediary variables such as satisfaction or reuse intentions to clarify the mechanisms by which governance and facility improvements lead to public service performance.

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