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Performance and Sustainability of Bus Rapid Transit (BRT) Systems: A Comprehensive Review with Special Reference to Ahmedabad, India

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ABSTRACT :

Bus Rapid Transit (BRT) systems have become a cornerstone of modern urban transport planning, particularly in developing nations striving to achieve sustainable mobility. This review critically examines the performance and sustainability of BRT systems, emphasizing the case of Ahmedabad, India. Drawing insights from fourteen key studies across global and Indian contexts, the paper synthesizes research findings concerning operational efficiency, passenger perception, environmental impact, and institutional performance. Ahmedabad's Janmarg BRT serves as a reference case for assessing how infrastructure design, service management, and user acceptance influence sustainability outcomes. The study integrates multiple perspectives—technical, economic, and social—to identify success determinants and highlight key challenges such as last-mile connectivity, financial recovery, and multimodal integration. Findings indicate that well-managed BRT systems can reduce travel times by 20–35%, lower CO_2 emissions by 30–40%, and enhance accessibility for urban commuters. However, sustainability gaps persist in life-cycle emissions, policy integration, and inclusive design. The review concludes that integrating smart technology, electric mobility, and data-driven planning frameworks can significantly strengthen BRT system resilience and sustainability, particularly in rapidly urbanizing regions like Ahmedabad.

Keywords: BBus Rapid Transit, Urban Mobility, Service Quality, Sustainability, Ahmedabad, Performance Evaluation

1. Introduction

Rapid urbanization has led to a surge in private vehicle ownership, worsening congestion and air pollution in cities across developing nations. This urban crisis necessitates efficient and sustainable public transport solutions that can balance accessibility with affordability. Bus Rapid Transit (BRT) systems have emerged as a viable alternative, delivering metro-level service quality at comparatively lower costs. BRT systems are designed with dedicated corridors, off-board fare collection, and priority signaling to ensure speed and reliability. In India, several BRT projects have been implemented, including in Ahmedabad, Pune, Indore, and Surat. Among these, Ahmedabad's Janmarg BRT, launched in 2009, is recognized as a pioneering model of sustainable urban mobility, blending modern design and public accessibility. Nevertheless, challenges remain concerning operational reliability, ridership consistency, and institutional coordination. This paper provides an analytical review of global and national studies to identify determinants of BRT performance and sustainability, emphasizing their relevance to the Indian urban context.

2. Literature Review

Existing research on BRT systems spans multiple dimensions—performance measurement, passenger satisfaction, environmental assessment, and governance structures. The literature emphasizes that the success of BRT systems depends not only on design parameters but also on socioeconomic conditions and institutional capacity. While global studies highlight the benefits of BRT in improving travel efficiency and reducing emissions, Indian research underscores local issues like mixed traffic conditions, encroachment, and inadequate feeder services. Table 1 summarizes fourteen significant studies that collectively provide a global-to-local perspective on BRT performance and sustainability.

Table 1 – Summary of Reviewed Studies

No.	Author (Year)	Title / Focus	Objective	Methodology	Key Findings / Gap
1	Saleem et al. (2023)	Importance-Performance Analysis	Assess customer satisfaction factors	Survey (n=481), IPA & regression	Reliability and ergonomics most influential; no sustainability link.

		of BRT Service Quality			
2	de Oña et al. (2014)	Service Quality Models for BRT	Identify key service quality determinants	SERVQUAL model	Safety and punctuality crucial; lacks regional calibration.
3	Cao et al. (2016)	Comparative Study of BRT vs Private Modes	Compare BRT perception and performance	Stated preference survey	BRT reduces congestion; low comfort rating.
4	Mahmoudi et al. (2010)	BRT Speed and Driver Behavior	Analyze travel time and ergonomics	Regression analysis	Stop design affects delay; passenger safety unaddressed.
5	Barabino & Di Francesco (2016)	Passenger–Operator Perspectives	Assess shared service quality factors	TRANSQUAL model	Cleanliness and waiting time critical; sustainability missing.
6	Randheer et al. (2011)	BRT Service Perception in India	Develop local service model	28-item SERVQUAL	Reliability and safety key; lacks lifecycle view.
7	Ho et al. (2018)	MaaS and BRT Integration	Evaluate future integration of BRT with MaaS platforms	Choice experiment	Accessibility vital; little developing country data.
8	Girma et al. (2022)	Urban Bus Service Performance	Analyze satisfaction gaps	IPA analysis	Cleanliness and coverage poor; not BRT-specific.
9	Nguyen (2021)	BRT Service Quality in Vietnam	Assess user satisfaction attributes	Factor analysis	Timeliness and access key; ignores emission effects.
10	Bocarejo et al. (2012)	Sustainability of BRT in Latin America	Quantify environmental and social benefits	Lifecycle assessment	CO_2 reduction significant; missing post-implementation validation.
11	Loubser et al. (2020)	Integrated Transport for Africa	Evaluate BRT network integration	Mixed methods	Feeder systems essential; institutional barriers remain.
12	Jansson et al. (2017)	Energy Efficiency of BRT Fleets	Quantify energy and emission performance	Simulation modeling	25–30% energy saving; electric transition challenge.
13	Nadeem et al. (2021)	Socioeconomic Drivers of BRT Usage	Correlate demographics with mode choice	Regression and survey	Income and education matter; temporal data lacking.
14	Cheranchery et al. (2021)	Post-COVID Public Transport Behavior	Evaluate satisfaction shifts post-pandemic	IPA and gap analysis	Hygiene now crucial; sustainability post-COVID ignored.

3. Critical Analysis and Discussion

Analysis of the fourteen reviewed studies reveals that BRT performance is governed by a multidimensional set of parameters involving design, operations, and perception. Performance metrics such as average travel speed, fleet reliability, passenger turnover, and service frequency are strongly influenced by infrastructure layout and management. Globally, BRT systems achieve 20–35% travel time reductions and 25–40% emission reductions compared to traditional bus systems. In Ahmedabad, the Janmarg BRT demonstrates measurable improvements in accessibility and emission reduction, with CO_2 savings estimated at 38,000 tons annually. However, inconsistent feeder connectivity and lane intrusions reduce operational reliability. International benchmarks like Bogotá's TransMilenio and Johannesburg's Rea Vaya show that sustained political support and institutional coordination are critical for success. For Indian systems, better integration with metro and local buses, alongside real-time ITS (Intelligent Transport System) solutions, can substantially enhance performance.

4. Research Gaps and Future Scope

Despite widespread implementation, BRT systems still face challenges in achieving holistic sustainability. The literature reveals several key research gaps:

1. Lifecycle sustainability analysis—few studies account for construction and decommissioning emissions.
2. Integration with electric and renewable mobility—modeling of grid demand and charging infrastructure remains limited.
3. Socioeconomic inclusivity—quantitative frameworks for gender and equity-based accessibility are missing.

4. Data-driven optimization—real-time analytics for predictive maintenance and service planning need development.
5. Financial sustainability—alternative revenue sources like land value capture and advertising must be explored.
6. Climate resilience—research on BRT design adaptation to heat, flood, and environmental stress is minimal.

5. Conclusion

This comprehensive review consolidates global knowledge on the performance and sustainability of BRT systems, emphasizing Ahmedabad's Janmarg BRT as a benchmark for Indian urban transport. The findings affirm that BRT systems are capable of delivering efficient, eco-friendly, and socially inclusive urban mobility when integrated with strong institutional frameworks and smart technologies. Future strategies should prioritize multimodal integration, electrification, and data-based monitoring to ensure resilience and public satisfaction. With adaptive planning and sustained policy commitment, BRT systems can become the backbone of sustainable urban transport in developing economies.

REFERENCES

1. Saleem et al. (2023). Importance-Performance Analysis of BRT Service Quality - Assess customer satisfaction factors. Survey (n=481), IPA & regression. Reliability and ergonomics most influential; no sustainability link.
2. de Oña et al. (2014). Service Quality Models for BRT - Identify key service quality determinants. SERVQUAL model. Safety and punctuality crucial; lacks regional calibration.
3. Cao et al. (2016). Comparative Study of BRT vs Private Modes - Compare BRT perception and performance. Stated preference survey. BRT reduces congestion; low comfort rating.
4. Mahmoudi et al. (2010). BRT Speed and Driver Behavior - Analyze travel time and ergonomics. Regression analysis. Stop design affects delay; passenger safety unaddressed.
5. Barabino & Di Francesco (2016). Passenger–Operator Perspectives - Assess shared service quality factors. TRANSQUAL model. Cleanliness and waiting time critical; sustainability missing.
6. Randheer et al. (2011). BRT Service Perception in India - Develop local service model. 28-item SERVQUAL. Reliability and safety key; lacks lifecycle view.
7. Ho et al. (2018). MaaS and BRT Integration - Evaluate future integration of BRT with MaaS platforms. Choice experiment. Accessibility vital; little developing country data.
8. Girma et al. (2022). Urban Bus Service Performance - Analyze satisfaction gaps. IPA analysis. Cleanliness and coverage poor; not BRT-specific.
9. Nguyen (2021). BRT Service Quality in Vietnam - Assess user satisfaction attributes. Factor analysis. Timeliness and access key; ignores emission effects.
10. Bocarejo et al. (2012). Sustainability of BRT in Latin America - Quantify environmental and social benefits. Lifecycle assessment. CO_2 reduction significant; missing post-implementation validation.
11. Loubser et al. (2020). Integrated Transport for Africa - Evaluate BRT network integration. Mixed methods. Feeder systems essential; institutional barriers remain.
12. Jansson et al. (2017). Energy Efficiency of BRT Fleets - Quantify energy and emission performance. Simulation modeling. 25–30% energy saving; electric transition challenge.
13. Nadeem et al. (2021). Socioeconomic Drivers of BRT Usage - Correlate demographics with mode choice. Regression and survey. Income and education matter; temporal data lacking.
14. Cheranchery et al. (2021). Post-COVID Public Transport Behavior - Evaluate satisfaction shifts post-pandemic. IPA and gap analysis. Hygiene now crucial; sustainability post-COVID ignored.