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Enhancing Bus Rapid Transit System (BRTS): A Study on Facilities Improvement for Upgrading User Experience in India

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Abstract: *Bus Rapid Transit Systems (BRTS) have emerged as a promising solution to urban transportation challenges in India. Despite their potential benefits, BRTS systems often encounter issues related to user experience, including accessibility and convenience. This research paper aims to investigate key facilities that can be improved in BRTS systems to enhance user experience, examine strategies for enhancing accessibility and convenience for passengers, and identify potential technological or infrastructural upgrades that can improve overall user experience in BRTS. Through a comprehensive review of literature, case studies, and expert interviews, this study seeks to contribute to ongoing efforts to enhance the quality and efficiency of public transportation systems in India.*

Keywords: Urban Transportation, Public Transportation, Bus Rapid Transit System (BRTS), User Experience.

Introduction

In India, there's an innovative form of public transportation known as the Bus Rapid Transit System (BRTS). It offers a safe, rapid, and cost-effective means of travel, tailored to the needs of urban commuters. BRTS is designed to provide efficient and convenient transportation options, ensuring passengers can navigate the city swiftly and comfortably. It represents a modern solution to urban mobility challenges, presenting a professional and reliable mode of transportation for individuals seeking efficient transit experiences in the Indian context.

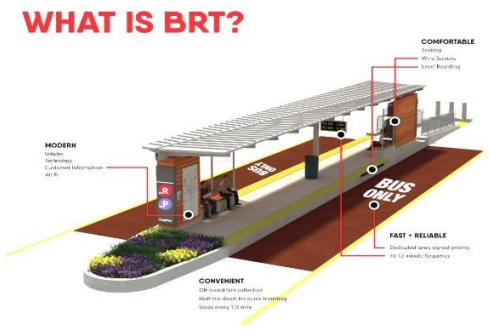


Figure 1 BRTS explanation

BRTS (Bus Rapid Transit System) has emerged as an efficient and sustainable public transportation mode in many urban areas. It offers a cost-effective and convenient alternative to private vehicles, reducing traffic congestion and promoting a greener environment. However, to ensure the success and widespread adoption of BRTS, it is crucial to continuously improve the facilities and services provided to enhance the user experience.

Background study:

- Urbanization: With rapid urbanization, cities are facing increasing challenges related to traffic congestion, pollution, and inefficient public transportation systems.
- Need for Efficient Public Transport: Traditional bus systems often struggle with issues like irregular schedules, overcrowding, and slow travel times due to mixed traffic conditions.
- BRTS Concept: BRTS was developed as a response to these challenges, offering a high-quality, high-capacity bus-based transit system that combines the efficiency of rail transit with the flexibility of buses.
- Global Adoption: BRTS has gained popularity globally, with successful implementations in cities like Bogotá, Curitiba, and Istanbul, showcasing its adaptability to diverse urban environments

Significance and Need of BRTS:

- Accessibility: BRTS improves accessibility for all residents, including those with limited mobility, by providing dedicated lanes, level boarding, and priority at intersections.
- Affordability: Compared to rail-based systems, BRTS is often more cost-effective to implement, making it an attractive option for cities with budget constraints.
- Reduced Congestion: By providing dedicated lanes and efficient boarding processes, BRTS helps reduce congestion on city roads, benefiting both transit users and private vehicle commuters.
- Environmental Benefits: BRTS promotes sustainable urban mobility by reducing greenhouse gas emissions, air pollution, and reliance on private vehicles.
- Economic Development: Well-planned BRTS systems can stimulate economic development by improving access to

employment centres, educational institutions, and commercial areas.

The Bus Rapid Transit System (BRTS) has undergone significant evolution since its inception, adapting to the changing needs of urban transportation. Initially conceived as a response to the limitations of traditional bus systems and the high cost of rail-based transit, BRTS has evolved into a sophisticated and efficient mode of public transportation.

Evolution of BRTS:

Early Concepts: BRTS originated in the 1970s, with pioneering implementations in cities like Curitiba, Brazil, and Bogotá, Colombia. These systems introduced dedicated bus lanes, priority signalling, and level boarding, laying the groundwork for future developments.

Global Expansion: BRTS gained traction globally, with implementations in diverse urban contexts, including developed and developing countries. This expansion led to innovations in design, technology, and operational practices.

Integration and Upgrades: Over time, BRTS systems have integrated with other modes of transportation, such as cycling infrastructure and metro networks. Technological advancements, such as real-time passenger information systems and contactless fare payment, have further enhanced the user experience.

Characteristics:

- Dedicated Infrastructure: BRTS typically operates on dedicated lanes, separated from regular traffic, ensuring faster and more reliable service.
- High-Quality Stations: BRTS stations are equipped with amenities such as shelters, seating, and real-time information displays, enhancing comfort and convenience for passengers.

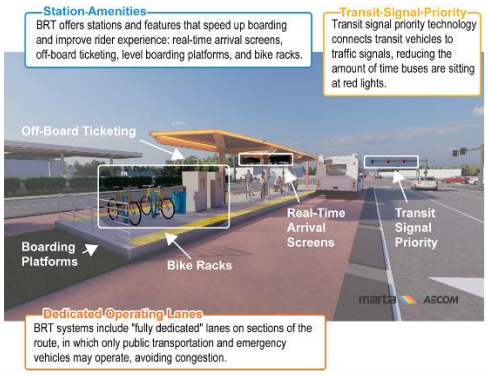


Figure 2 Characteristics of BRTS

- Priority Measures: BRTS vehicles are given priority at intersections through signal pre-emption or dedicated lanes, minimizing delays and improving overall travel times.
- Efficient Boarding: BRTS employs level boarding platforms and multiple doors for rapid boarding and alighting, reducing dwell times at stations.
- Service Frequency: BRTS systems often offer high-frequency service, with buses arriving at regular intervals, ensuring minimal waiting times for passengers.

Factors Influencing User Experience in BRTS:

- Several factors influence the user experience in Bus Rapid Transit Systems, impacting passenger satisfaction, comfort, and convenience.
- Accessibility: The ease of accessing BRTS stations and vehicles, including features such as ramps, elevators, and tactile paving, influences the experience of passengers with mobility impairments.
- Comfort: Factors such as seating comfort, climate control, and cleanliness of vehicles and stations contribute to passenger comfort during the journey.
- Information Provision: Clear and timely communication of route information, schedules, and service disruptions enhances the user experience by reducing uncertainty and anxiety.
- Safety and Security: Measures to ensure passenger safety, such as adequate lighting, surveillance cameras, and presence of staff or security personnel, contribute to a sense of security among passengers.
- Ticketing and Fare Payment: The simplicity and convenience of fare payment methods, including options for contactless payment or integrated ticketing with other modes of transportation, influence the ease of use and overall satisfaction with the BRTS system.
- Reliability and Punctuality: Consistency in service frequency, adherence to schedules, and reliability in operation contribute to passenger trust and satisfaction with the BRTS system.

Case Study of some existing and discontinued Bus Rapid Transit System (BRTS) in India

➢ **AHMEDABAD BRTS**

The case study on the Bus Rapid Transit System (BRTS) in Ahmedabad, India, focuses on the Janmarg BRTS project and its impact on sustainable transport and urban development. Here is a summary of the key points discussed in the case study:

- Introduction to BRTS: The BRTS in Ahmedabad is recognized for its sustainable transport system, aiming to provide efficient and cost-effective public transportation solutions for the city.

- Advantages of BRTS: The BRTS system offers various advantages, including reduced traffic congestion, improved safety, enhanced air quality, efficient operations, increased accessibility, modal shift towards public transport, cost-effectiveness, and contribution to sustainable development.
- Technical Innovations: The BRTS project in Ahmedabad incorporates technical innovations in bus service operations and infrastructure to optimize speed, comfort, and capacity, aligning with the service quality of rail transit while maintaining the flexibility of bus transit.
- Impact Analysis: The study evaluates the impact of BRTS on traffic flow, average speed, accidents, pedestrian safety, and air quality along the corridors, highlighting positive outcomes such as reduced congestion, improved traffic management, increased speed, modal shift from two-wheelers to BRT, decreased accidents, and slight improvements in air composition.
- Sustainable Transport: The implementation of BRTS in Ahmedabad has led to a reduction in accidents, improved air quality, and increased operational efficiency, contributing to a more sustainable and efficient urban transport system.
- Success of BRTS: The conclusions drawn from the analysis indicate the successful application of the BRT corridor in reducing congestion, managing traffic effectively, increasing average speed, shifting commuters to BRT from two-wheelers, decreasing accidents, and improving air quality along the corridors.

Overall, the case study underscores the significance of BRTS in promoting sustainable transport, enhancing urban mobility, and addressing key challenges related to traffic congestion, air pollution, and road safety in cities like Ahmedabad.

➢ INDORE BRTS

The analysis of the Bus Rapid Transit System (BRTS) in Indore City provides valuable insights into the system's performance, user satisfaction, and impact on urban transportation.

- The study highlights the efficiency of the BRTS in accommodating a significant number of passengers daily and catering to diverse user demographics, particularly focusing on educational and work-related travel.
- Key findings include identified traffic congestion hotspots along the BRTS route, projected passenger growth rates, and the system's positive reception among users.
- Recommendations put forth in the analysis aim to further enhance the efficiency of the BRTS system by addressing congestion, planning for future capacity needs, upgrading infrastructure, improving user experience, and promoting sustainable transport solutions.
- By implementing these recommendations, the BRTS system in Indore can continue to serve as a reliable and sustainable mode of transportation, meeting the evolving needs of the city's residents while contributing to a more efficient and eco-friendly urban transport network.
- Overall, the analysis underscores the importance of continuous evaluation, strategic planning, and proactive measures to optimize the performance and effectiveness of the BRTS system in Indore City, ensuring a seamless and sustainable transportation experience for all stakeholders.

➢ DELHI BRTS

The study of Delhi's Bus Rapid Transit System (BRTS) highlighted several key issues and challenges that contributed to the system's failure.

- These included poor planning, operational inefficiencies, lack of public support, infrastructure challenges, and inadequate enforcement, among others.
- The BRTS in Delhi faced significant problems such as long queues in general traffic lanes, bus breakdowns, pedestrian safety concerns, and encroachments on bus lanes, which affected the system's reliability and effectiveness.
- Ultimately, the study concluded that the Delhi BRTS failed to achieve its intended objectives of providing efficient, reliable, and sustainable public transportation due to a combination of planning, operational, and governance shortcomings.
- The dismantling of the BRT corridor in Delhi underscored the need for comprehensive and well-executed urban transport solutions that address the diverse needs of commuters, integrate with existing transport systems, and prioritize safety and efficiency.
- Moving forward, the study emphasized the importance of learning from the failures of the Delhi BRTS to inform future urban transport planning and implementation efforts.
- By addressing the identified challenges, improving stakeholder engagement, enhancing operational practices, and ensuring sustainable funding and governance mechanisms, cities can develop successful and sustainable public transportation systems that meet the needs of their residents and contribute to more efficient and liveable urban environments.

➢ BHOPAL BRTS

The case study of MYBUS, the Bus Rapid Transit System (BRTS) in Bhopal, Madhya Pradesh, can be summarized as follows:

- Implementation and Functionality: The MYBUS BRTS system in Bhopal became functional in 2013, aiming to compensate for increasing congestion and provide a sophisticated public transit system. The system is funded by the central government under the JNNURM scheme and operated by the Bhopal City Link Limited (BCLL).
- Infrastructure Characteristics: The Bhopal BRTS infrastructure consists of dedicated busways, pedestrian access facilities, bus stops, and an advanced control system. The system includes trunk, standard, complimentary, and intermediate para transit routes with a corridor spanning 24 kilometres.
- Challenges and Areas for Improvement: The MYBUS BRTS system in Bhopal faces challenges related to system sophistication, mixed traffic issues, bus stop design, integration with local buses, safety measures, and public amenities. These areas require attention and improvement to enhance the overall efficiency and effectiveness of the BRT system.
- Scope for Enhancement: There is a significant scope for improvement in the planning, design, and implementation of the Bhopal BRTS system. Measures such as maintaining high average trip speeds, ensuring transit supportive land development, and implementing priority signalling can enhance the system's performance and user experience.
- Recommendations for Future Development: To make the BRT system in Bhopal more organized and effective, it is essential to address the identified shortcomings and implement measures to enhance system reliability, safety, and passenger convenience. Improving system identity, vehicle design, and overall operational efficiency are crucial for the success of the BRTS in Bhopal.

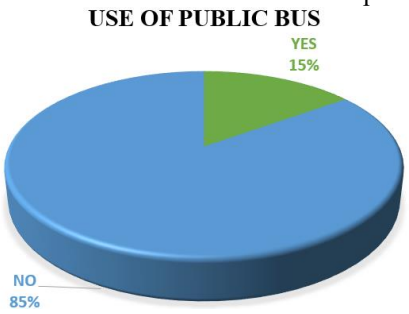
In conclusion, while the MYBUS BRTS system in Bhopal has been operational since 2013 and aims to address urban mobility challenges, there are areas for improvement to enhance its functionality, efficiency, and user experience. By addressing the identified challenges and implementing recommended enhancements, the BRT system in Bhopal can better serve the transportation needs of the city's residents and contribute to a more sustainable and efficient urban transport network.

Survey

A local survey was carried out amongst the general public to obtain their opinion and views on the BRTS and its services. The survey consisted only few questions, which are listed below:

1. Do you use public buses (City Bus or BRTS)?
2. Are the bus stations easily accessible to you?
3. Transit method from home/destination to bus stations or bus stations to home/destination?
4. Do bus stations feel comfortable and safe to you?
5. Are the buses comfortable to you?
6. Will you use it more often if feeder services are provided to reach bus stations?
7. Should parking facilities be provided near bus station of private vehicles?
8. Are pedestrian crossing and dedicated pathways required near bus stations?

The outcomes of the survey are represented in the following pie charts:

1. 

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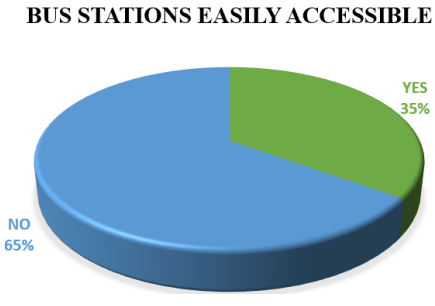
2. 

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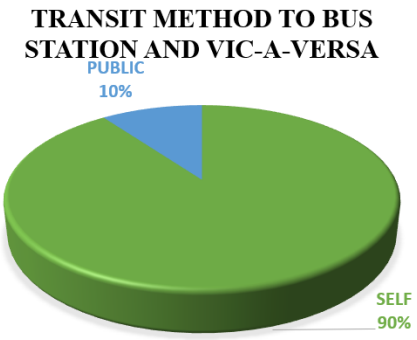

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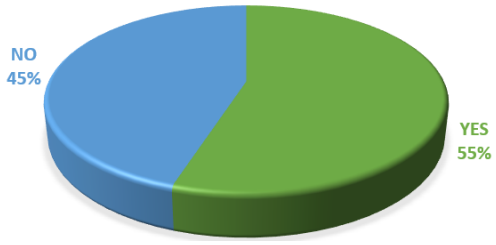

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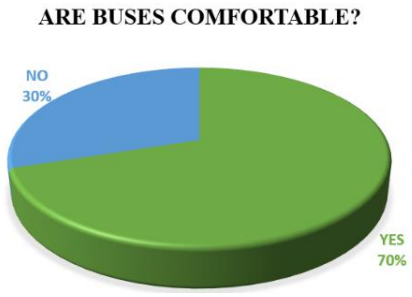

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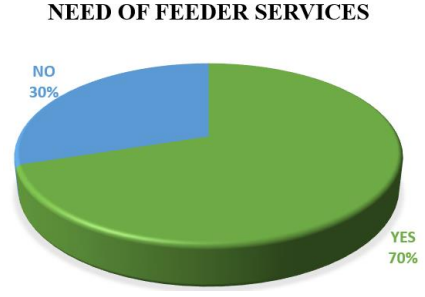

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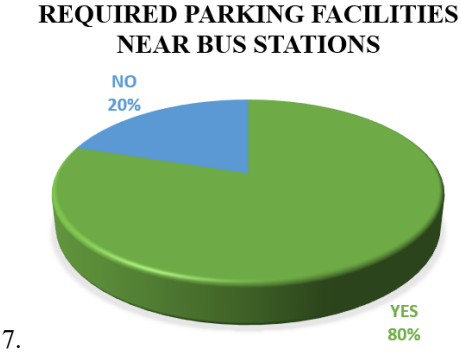

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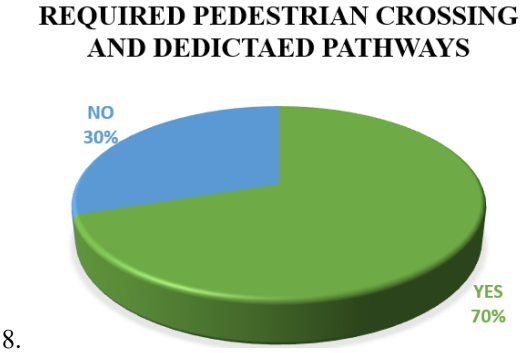

Chart 8

The Bus Rapid Transit System (BRTS) incorporates several key features to enhance its efficiency and effectiveness in providing urban transportation.

➢ **Stations and Terminals:**

- Design Improvements: Enhancing the layout and architecture of stations and terminals to improve functionality and aesthetics, ensuring they blend seamlessly with the urban environment.
- Passenger Amenities: Upgrading passenger amenities such as seating arrangements, lighting systems, and information displays to provide greater comfort and convenience to commuters.
- Accessibility Features: Installing ramps, elevators, tactile paving, and other accessibility features to ensure that stations and terminals are easily accessible to all passengers, including those with disabilities or mobility challenges.

Improving these aspects of BRTS stations and terminals can significantly enhance the overall user experience and encourage greater ridership.

Figure 3 Features of BRTS

➢ **Vehicle Fleet:**

- Upgrading Vehicles for Comfort and Efficiency: Investing in newer, more comfortable, and fuel-efficient buses to improve passenger comfort and reduce environmental impact.
- Providing Feeder Services: Integrating feeder services to complement the main BRTS routes, providing convenient access to areas not directly served by the BRTS system.
- Integration of Technology: Incorporating modern technology features such as Wi-Fi connectivity and USB charging ports onboard buses to enhance the passenger experience and meet the expectations of modern commuters.

By focusing on these aspects of the vehicle fleet, BRTS operators can enhance the attractiveness and efficiency of the system, ultimately encouraging more people to choose public transportation for their daily commute.

➢ **Ticketing and Fare Collection:**

- Implementation of Contactless Payment Systems: Introducing contactless payment systems such as smart cards, mobile payment apps, or contactless credit/debit cards to streamline the fare payment process and reduce boarding times.
- Improving Ticket Vending Machines and Fare Gates: Upgrading ticket vending machines and fare gates with intuitive interfaces, faster processing speeds, and enhanced reliability to ensure smooth transactions and minimize passenger queues.

By enhancing ticketing and fare collection facilities in BRTS systems, operators can improve the overall efficiency of fare collection processes, enhance passenger convenience, and encourage greater ridership.

➢ **Information and Communication:**

- Real-Time Passenger Information Systems: Implementing real-time passenger information systems at stations and onboard vehicles to provide up-to-date information on bus arrivals, departures, and service status. This allows passengers to plan their journeys more effectively and reduces uncertainty.
- Clear Signage and Wayfinding Aids: Installing clear signage and wayfinding aids at stations and along BRTS corridors to guide passengers to their destinations, including route maps, directional signs, and information about nearby attractions or facilities.

By enhancing information and communication facilities in BRTS systems, operators can improve passenger satisfaction, reduce travel stress, and promote the use of public transportation as a convenient and reliable mode of travel.

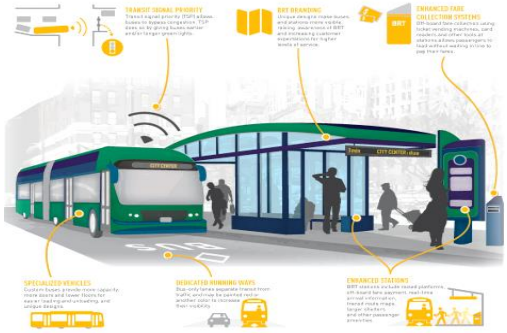

Figure 4 Features of BRTS

➢ **Safety and Security:**

- Surveillance Cameras: Installing surveillance cameras at stations, terminals, and onboard vehicles to monitor activities and deter potential incidents. These cameras can also aid in the investigation of accidents or security breaches.

- Emergency Communication Systems: Implementing emergency communication systems such as emergency call buttons or intercoms at stations and onboard vehicles to allow passengers to quickly communicate with transit staff in case of emergencies or security concerns.
- Enhanced Lighting and Visibility: Improving lighting infrastructure at stations, terminals, and along BRTS corridors to enhance visibility and deter criminal activities. Well-lit areas also contribute to passengers feeling safer and more secure while waiting for buses or traveling at night.

By focusing on these aspects of safety and security, BRTS operators can create a safer and more secure environment for passengers, staff, and the general public, thereby enhancing confidence in the system and encouraging greater ridership.

To improve Bus Rapid Transit Systems (BRTS) in India, more measures can be adopted which are as under:

1. Dedicated Bus Lanes: Ensure exclusive lanes for buses to reduce congestion and travel time. These lanes should be physically separated from regular traffic.
2. Priority at Intersections: Implement signal prioritization for buses at intersections to minimize waiting times, allowing buses to pass through without delay.
3. High-Quality Bus Fleet: Invest in modern, comfortable buses with low emissions to attract more passengers and improve overall service quality.
4. Integrated Ticketing Systems: Introduce smart card systems or mobile ticketing apps that allow seamless transfers between different modes of public transportation, making it convenient for passengers.
5. Real-Time Information: Provide real-time information about bus arrival times and service updates through apps, electronic displays at stations, or SMS alerts to improve passenger convenience and reduce uncertainty.
6. Accessibility: Ensure that BRTS stations and buses are accessible to people with disabilities, including ramps, low-floor buses, and audio announcements.
7. Safety Measures: Implement security cameras, emergency buttons, and onboard staff to enhance passenger safety and prevent incidents of harassment or theft.
8. Public Awareness Campaigns: Launch campaigns to educate the public about the benefits of BRTS, encourage modal shift from private vehicles, and promote responsible behaviour among passengers.
9. Infrastructure Upgrades: Continuously maintain and upgrade BRTS infrastructure including stations, shelters, signage, and roads to ensure smooth operations and a positive passenger experience.
10. Community Engagement: Involve local communities and stakeholders in the planning and decision-making process to address concerns, gather feedback, and build support for BRTS projects.
11. Traffic Enforcement: Enforce strict traffic regulations to prevent encroachment into bus lanes, illegal parking, and other activities that impede the efficiency of the BRTS.
12. Feeder Services: Introduce feeder services such as feeder buses, bicycle-sharing systems, or pedestrian infrastructure to improve connectivity to BRTS stations and enhance accessibility for passengers.
13. Regular Maintenance: Implement regular maintenance schedules for buses, infrastructure, and equipment to ensure reliable service and minimize disruptions due to breakdowns or malfunctions.
14. Capacity Building: Train bus drivers, station staff, and management personnel to improve operational efficiency, customer service, and emergency response capabilities.
15. Separate Stations: Stations are designed to be convenient, comfortable, secure, and weather-protected, offering level access between platforms and bus floors.
16. Intermodal Connectivity: Special stations and terminals facilitate seamless connections between trunk routes, feeder services, and other modes of public transport.
17. Pre-boarding Fare Collection: Fare collection and verification processes are conducted before boarding, streamlining passenger flow, and reducing boarding times.
18. Centralized System Management: A centralized control centre manages system operations, utilizing Intelligent Transportation System (ITS) applications such as automatic vehicle location for efficient management.
19. Accessibility Features: Special provisions are made to ease access for people with disabilities, including children, the elderly, and individuals with mobility challenges, ensuring inclusivity and accessibility for all passengers.
20. Clear Route Maps and Signage: Easily visible route maps, signs, and real-time information displays within stations and vehicles help passengers navigate the system effectively and stay informed about their journey.

These features collectively contribute to the effectiveness, reliability, and convenience of BRTS systems, making them a preferred choice for urban transportation in many cities around the world.

Conclusion:

The study concludes that improving facilities is crucial to improving accessibility and user experience for Bus Rapid Transit Systems (BRTS) in India. Through the implementation of strategies aimed at improving passenger convenience and addressing critical challenges, BRTS systems can be made more user-friendly and efficient. The study emphasises how important it is to make infrastructure and technology improvements in order to enhance the general user experience in public transport systems. Cities in India can address issues related to urban mobility, enhance the quality and efficiency of BRTS systems, and develop more effective and environmentally friendly urban

transportation networks by continuously working to improve these factors.

While BRTS has the potential to address urban mobility challenges and promote sustainable transport, there are areas for improvement, such as station design enhancements, technological upgrades, and service improvements, as demonstrated by case studies of BRTS systems in cities like Ahmedabad, Indore, Delhi, and Bhopal. The study also emphasises how important stakeholder participation, strategic planning, and long-term funding sources are to the effective deployment of BRT systems.

In India, Bus Rapid Transit (BRT) systems have the potential to enhance urban environments and make cities more liveable and sustainable by tackling issues, improving facilities, and putting forward suggestions for future growth. The study concludes by highlighting the necessity of proactive measures, ongoing assessment, and enhancement of BRTS performance in order to improve India's urban transport system as a whole.

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