WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

An Investigation on the Bus Rapid Transit System in India with the Aim of Reducing Accidents

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ABSTRACT:

BRTS, or Bus Rapid Transit System, represents India's cutting-edge public transportation solution that is secure, affordable, efficient, and user-friendly. More than 150 B.R.T.S series are currently operational and thriving globally, including in cities like Bogota, Beijing, and Ahmedabad (India). India boasts the second-largest population and an economy that is growing at an impressive pace. India has a population of 130 million, with 42 million individuals residing in rapidly growing urban areas. Nonetheless, urban transportation has remained stagnant for decades, and the rapid rise of automobiles on city roads has led to congestion and traffic jams in most Indian cities. Addressing mobility in urban areas is essential at this moment. The Bombay Regional Transit System (BRTS) stands out as India's most economical and eco-conscious transit solution for growing urban areas. Several factors contribute to the inadequate quality of public transportation in India, such as overloading, inconsistent pricing, untrained drivers and workers, and uncoordinated movement. The combination of these factors renders public transportation both unpleasant and hazardous. In most Indian cities, public transportation is managed by the unorganized sector. Conversely, a BRT network with extensive coverage can efficiently transport a significant number of passengers swiftly and reliably throughout the day, while also providing a pleasant journey for individuals across all economic backgrounds. To effectively serve a diverse market or deliver high-frequency service without relying on subsidies, these traits are crucial.

Keywords: - B.R.T.S, Developing Cities, Urban Public Transportation.

Introduction

BRT depends on buses for its public transit system. True BRT systems stand out due to their distinctive design, services, and infrastructure, enabling them to enhance quality and eradicate common causes of bus delays. BRT is characterized as a novel, high-capacity, cost-effective public transit option that has the potential to greatly enhance urban mobility. The National Bus Rapid Transportation Institute sometimes describes BRT as a "surface subway." This enduring and cohesive system utilizes buses or other specialized vehicles on roads or dedicated lanes to transport passengers swiftly and effectively, all while addressing the demand for public transportation. Bus Rapid Transit (BRT) systems can be tailored to address community needs while leveraging affordable, advanced technology to enhance ridership and alleviate congestion. The objective of bus rapid transit (BRT) is to merge the capacity and speed of light rail or metro with the flexibility, cost-effectiveness, and straightforwardness of buses. BRT buses must operate for a considerable portion of their route within a designated right of way exclusively for their use (the bus way) to prevent traffic congestion. The first BRT system was established in 1974, known as the Read Intergrade de Transported in Curitiba, Brazil. However, during that period, this method was not commonly adopted. In 2000, Bogotá, Colombia, saw the establishment of the Trans Milano system. The achievement was monumental, and it disseminated the idea of BRT worldwide. With 100 BRT Systems currently operational worldwide and an additional 150 under development, concerns regarding the efficacy and efficiency of BRT have been effectively addressed.

Ajay Mishra et.al (2013) The advancement of a country's transportation systems is crucial for its overall development. The implementation of BRT systems has effectively addressed congestion, delays, accidents, and various other issues. The development of BRTS is more cost-effective than that of metro rails and light rail transits, as existing highways may be modified. BRTS stands out in meeting the needs of society, especially as many of our cities face considerable challenges with public transportation. The main benefits of this AI include its high-capacity design, durability, and accessibility for public use. This paper consists of five sections. At the outset, there is an introduction. The next step involves examining the pertinent literature. A summary of prior research on this topic is included. The third section discusses two distinct case studies. The fourth section presents ideas grounded in case studies and literature. This concludes the fifth section. BRTS operates in the Indian cities of Ahmadabad, Indore, Jaipur, Rajkot, Bhopal, Delhi, and Pune. The systems in question fail to align with international standards, except for Ahmadabad. Poor design, a rise in private vehicle usage, and insufficient amenities at bus stops create challenges for daily life. In India, the vision of pollution-free autos remains an elusive aspiration. This paper aims to explore innovative strategies that could improve the cost, time, and quality of the current BRTS. India is prioritizing the development of SMART cities. This

concept has the potential for greater success through the implementation of intelligent transportation technology. BRTS fulfills this essential requirement. The Bombay Regional Transport System (BRTS) is set to become the flagship public transportation system for Indian cities in the future.

1.2 Furthermore, an authentic BRT system will encompass most of the following elements:

(i) Central bus lanes are necessary to prevent delays at the curbside.

(ii)Stations that gather fares off-board to minimize the time spent waiting for boarding.

(iii) Align station platforms with bus floors to minimize the time required for boarding.

(iv) Buses ought to be given priority at intersections to prevent signal delays.

(v) Exclusive lanes to enhance speed and reduce travel times

(vi) Vehicles designed to hold a larger number of passengers

3. A Subsequent Examination of the Literature

A multitude of researchers and scholars in civil engineering have explored the optimization of public transportation demand.

Sharma Anupama (2010) found that the BRTS navigates along canal banks, traverses streets, and crosses streets throughout its route. It is indeed feasible to operate BRTS on elevated structures or within tunnels. The ideal location for this system is within surface communities. Compact stations and highways are more effective. Bus Rapid Transit System (BRTS) projects with more exclusive running ways significantly reduce travel time compared to local bus routes. Exclusive transit projects in other countries achieve an average speed of 35 kilometers per hour, while arterial BRT systems operating in mixed traffic or with designated lanes typically reach speeds of 20-25 kilometers per hour.

The Centre for Environmental Planning and Technology, located at Ahmedabad University, was established in 2006.

The proposed BRTS project may lead to various impacts, contingent upon the project's specifics and the surrounding environmental conditions. A notable environmental benefit is the decrease in accidents and traffic congestion on the roads. There will be enhancements in both service and safety, a decline in fuel consumption, a decrease in air pollution, and a more efficient flow of traffic throughout the city across all modes. While the removal of plants and the expansion of pavement do not influence macroclimatic variables such as precipitation, temperature, and wind along road corridors, there may be temporary effects on the microclimate due to these factors. The bulk of the negative effects are limited to locations adjacent to the roadway. Throughout the day, the temperatures of the roads and soil could increase if shade trees are removed. The canopy is expected to be restored within a span of ten to fifteen years, provided that trees are replanted.

In 2011, Senes Consultants India Pvt. Ltd. carried out an environmental impact assessment for the proposed bus rapid transit system in Naya Raipur.

Naya Raipur, being a young and developing city in Chhattisgarh, is expected to experience a peak hour traffic demand of 12,000 PHPDT along key roads once all planned developments are finalized. Given that Naya Raipur aims to emerge as a major economic driver across various sectors, it is crucial to establish a mass rapid transport system that is efficient, effective, environmentally conscious, safe, sustainable, and economically viable from the outset. A BRT system is being proposed for Naya Raipur to connect Raipur and its key routes. During Phase I (2013), the system capacity will adequately satisfy traffic demand, and it will progressively expand in later phases to facilitate the development of Naya Raipur.

Journal of Public Transportation, Volume 12, Issue 2, 2009, The Features and Deployment of Bus Rapid Transit in American Cities

In general, buses and BRT vehicles differ from one another. It is common to observe ample capacities, low floors, comfortable seating, and several doorways that are quite spacious. The latest advancements have enhanced ride quality, comfort, and dwell time significantly. Articulated buses are frequently utilized. Articulated buses may be utilized solely in circumstances where there is a considerable demand for capacity that does not align with an increase in line frequency. Alongside the designs for stations and shelters, it is important to also consider the design of the vehicles. In the process of selecting and developing BRT cars, the significance of interior design cannot be overstated. The interior of a vehicle can offer passengers a delightful experience. In Beijing, the 60-foot BRT reduces the time required for boarding, resulting in a less favorable design. In cities across Asia and Latin America, high-floor vehicles are utilized to enhance the comfort of the travel experience when passenger demand is high. To draw in passengers, BRTs must ensure they have adequate geographical coverage. Extensive coverage, conversely, may require more stops and extended travel durations. Frequency serves as an important indicator of the quality of transportation services. A higher frequency results in reduced wait times for customers. This feature draws in riders and influences the duration of travel time. In Latin America, BRT headways are under one minute, whereas in the United States, they vary from three to twenty minutes. Given the high demand for passengers in India, the daily average headway should be under three minutes instead of three minutes.

BRT cars or fleets can indeed compete with rail-based mass transit systems regarding capacity. This competition depends on the vehicles' capacity, the extent of route coverage, and the frequency of operation. The demand for passengers in BRT systems in the United States is lower than that in systems found in Asia and Latin America, leading to a reduced design capacity.

Despite its limitations, bus rapid transit offers a cost-effective and flexible solution for establishing a rapid transportation system from the ground up. BRT may be adequate for routes in larger cities with moderate usage, as well as for smaller to medium-sized cities. With the increasing population in larger cities, the constraints and costs linked to a transportation system reliant solely on buses along heavily trafficked routes are becoming increasingly evident. Under specific circumstances, the appeal of light rail conversion increases significantly.

4. Methodology

Several research papers were reviewed to study how the road safety audit can be used in every possible parameter. Reviewing papers helped in determining and limitation and the scope of the study. Literature survey is definitely the most important part of any project as it shows us the proper direction from where to proceed and gives us an insight about the research done by various authors around the world. The main goal of this project is to carry out a road safety audit of the existing to identify locations of potential safety hazards and to suggest appropriate.

The methodology is divided in only three phases, which have a specific goal, the first phase is to find a trustworthy data source that have information of this problem around the world (see Fig. 5), the next phase is to select the most precise search criteria in order to debug not necessary information and finally, to obtain expected results. These three phases in figure 1

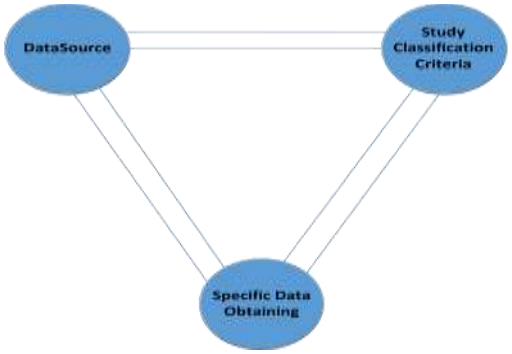


figure. 1. Research Methodology Proposal.

A study of BRT in India

BRT encompasses a range of transportation systems that utilize buses to deliver a service that surpasses the quality of conventional bus lines. This is achieved through improvements to the infrastructure, vehicles, and scheduling of the system. The BRT will transform public transportation in cities, garnering widespread support from residents and facilitating the city's expansion in a more efficient way. Numerous daily passenger trips originate in the city centers before arriving at their final destination. They will no longer have the opportunity to stop in the central business district. Prioritizing public transportation will lead to shorter travel times, significantly affecting the economy. Road users will experience shorter journey times right after construction, leading to decreased vehicle time and lower operating costs. The Indian government is implementing several BRTS projects across the country, notably in Ahmedabad, Indore, and Bhopal, as part of the JNNURM initiative. The corporations of the municipality are engaged in various activities. The following projects are currently active in table 1.

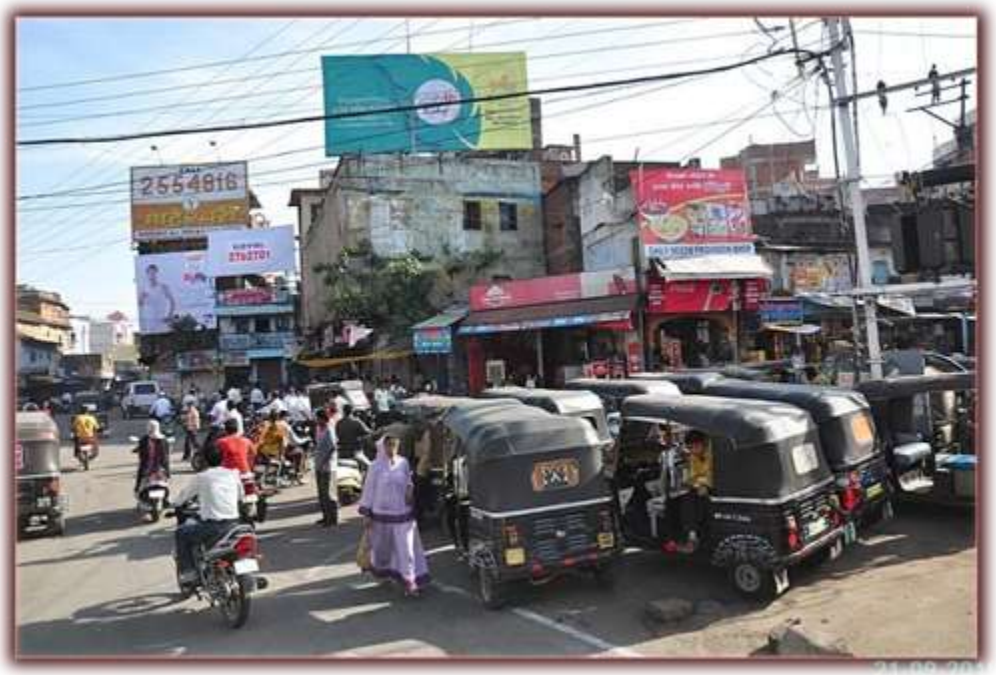
Table 1: Detail of BRTS Projects in India

Cities Name	Length (Km)	Segregation	System	Bus Stop Location
Delhi	14.7	partial	open	middle
Bhopal	23.71	partial	Partia llyopen	Middle /side
Ahmedabad	87.60	yes	closed	middle
Surat	29.80	yes	closed	middle
Rajkot	29.20	yes	closed	middle
Indore	12.45	yes	Partially open	middle
Vijaywada	15.60	yes	open	middle
Jaipur	26.20	yes	Partially open	middle
Vizag	42.70	yes	close	middle

Pune	124.70	partial	open	middle

4.1 The Necessity of the Project

The Boston Regional Transit System (BRTS) aims to deliver urban public transportation that is safe, convenient, and timely for the general public. Minimize the level of traffic on urban streets. A multitude of cities and towns in India are embracing exemplary practices from around the globe to meet the growing demand for urban mass transit mobility. The Jawaharlal Nehru National Urban Renewal Mission (JNNURM) is focusing on proposed urban and public transit projects in 63 cities to promote reforms and expedite planned development. Safe, Cities in India are adopting the Bus Rapid Transit System (BRTS) in figure 2, also known as the High Capacity Bus System (HCBS), due to its flexibility, cost-effectiveness, and multi functionality.



4.2 The Roles of the BRTS System

4.2.1. The Main Bus Rapid Transit System boasts several key features:

a. Bus lanes specifically designated for buses function independently from other roadways. Bus routes are highly reliable because only a select group of skilled drivers are authorized to transport passengers.

b. Bus routes can be designed to meet stricter standards, ensuring safety when compared to those accessible to non-professional drivers, potentially leading to lower construction costs. Position bus lanes in medians instead of in curb lanes.

c. An interconnected system of routes and corridors

d. Stations that prioritize convenience, safety, and protection from the elements

e. Offered distinctive stations and terminals designed to physically connect trunk routes, feeder services, and various public transportation networks.

f. Enabled access from the platform to the vehicle's floor.

g. Combining routes, corridors, and feeder services

h. Gathering fares and verifying passengers before boarding

i. The newly designed commercial and administrative structure will ensure that the system is accessible solely to authorized operators.

4.2.2 Innovations in vehicles that generate low emissions are complemented by ITS applications, such as vehicle location, which are utilized by a centralized control centre for effective system management.

a. Individuals with disabilities, including children and the elderly, qualify for specific physical accommodations.

b. Visible route maps, signage, and information displays should be present, with real-time updates at stations and vehicles.

c. A city centre identified as a bus street or transit mall, where all municipal lanes are solely allocated for bus use.

d. Bus turnouts, boarding islands, and curb realignments represent low-cost infrastructure components that can enhance responsiveness and reliability of bus service offerings. In cities with an extensive road network for private vehicles, BRTs can utilize dedicated bus lanes alongside existing roads to coverage throughout the entire city in figure 3

e. Delivers frequent service all day by addressing a diverse market: A BRT network with comprehensive coverage can effectively transport passengers from their current location to their destination promptly and reliably, all while providing an excellent customer experience.

Figure 3: Congested free BRTS Ride in Bhopal

4.4 Some of the many benefits of the Bus Rapid Transit System

With the opening of the first BRTS corridor in Ahmdabad two years ago, and more recently, the corridors in Indore and Bhopal have also begun functioning, the fast passenger transport system has contributed to a reduction in the city's infamously crowded roadways and the air pollution that is associated with them. The installation of the BRT is considered to be an economic development program that will have benefits in the short-term, the intermediate-term, and the long-term. In India, the primary focus is on ambitious plans for expanding cities that will serve as the foundation, if not the framework, for a new-look city with broad boulevards lined with landscaped pavements, multi-story parking structures, reasonably priced apartments, offices, shops, and entertainment venues. Both the city's physical and mental integration, as well as the quality of life of its citizens, will see substantial improvements that will be brought about by the system and the accessibility it offers. Furthermore, the availability of reliable public transit will "lead to more flexible employment and transportation arrangements and arrangements." for the time being, are usually constrained by the taxi and bus services that are already in existence. In the Short Term, the Benefits of BRT.

Public transportation systems that are reliable, consistent, and efficiently operated Ticket prices that are reasonable, a public transportation system that is safe and secure, public transportation that is accessible to mothers with children and people with disabilities, a reduction in energy consumption, vehicle emissions, and traffic congestion, an improvement in the urban environment, and a recapitalization of the public transportation fleet are all benefits in figure 4.

figure 4: Level Boarding at BRT Station in Bhopal**4.3.1 The Advantages of Bus Rapid Transit in the Intermediate Term**

Limiting urban sprawl, characterized by the expansion of several settlements, while promoting densification, Promoting social engagement instead of social seclusion

4.3.2 Enhancing career prospects Long-Term Advantages of BRT (figure 5)

a. Enhanced economic development in the regions around the nodes and along the mobility corridors, where applicable.

b. A transformation in land use will occur along the route and at the nodes, resulting in an increase in population density.

c. A public transportation system that is sustainable and operates often throughout both peak and off-peak hours.

d. All individuals using public transit will have reduced journey durations, and there will be a decrease in pollution levels.

e. The city may take pride in its world-class public transportation system.

figure 5: New Devlopment along The BRT in Pune.

4.4 The Environmental Impacts

Projected consequences resulting from the BRTS project have been noted. The implications have been assessed based on the specifics of the project and the current environmental conditions in Ahmedabad. The below enumeration is a synopsis of the beneficial environmental effects: An expedited flow of traffic across the city for all transportation modes

a. A reduction in traffic congestion;

b. An enhancement in service speed and safety;

c. A decline in road accidents;

d. A drop in air pollution; A reduction in fuel consumption.

4.5 Challenges Pertaining to the Rapid Transit System

To guarantee the prompt installation and functioning of the Bus Rapid Transit System, certain hazards are present:

a. Insufficient backing from the public transportation sector, since several operators are unwilling to endorse the initiative or resist transitioning to the new operations. Formulating a commercially and financially feasible concept by securing endorsement from current operators and investors.

b. Taxi groups have voiced their dissatisfaction with the government's choice to proceed with the implementation of the BRT without adequately elucidating its operational framework.

c. Taxi owners contend that they cannot compete with the BRT due to its exclusive use of dedicated lanes. The temporal aspect is one of the several obstacles encountered in the design of local BRT systems.

d. This includes the environmental impact assessment methodology and findings, which address concerns over increasing noise levels and resistance to the appropriation of current residences.

e. Delays and prolonged implementation may arise due to fiscal restrictions.

f. The first priority in garnering customer support is the individual's safety. Employ video surveillance with an augmented police presence to address the apprehensions of the public.

g. Concerns include negative evaluations of the comfort and length of bus travel relative to private vehicles and rail transit. Instructing proprietors and operators on the competencies required to manage Bus Rapid Transit effectively.

5. Users and prospective clients are receiving education/Unlike the metro and light train

Following the first BRT system's introduction in Curitiba in 1974, cities were hesitant to adopt it, as they perceived it could accommodate only 12,000 people in each direction during peak hours. This was the rationale for the delayed adoption. A primary justification for substantial investments in heavy rail metro systems in some regions was the capacity limitations present in the developing globe. The mean daily ridership in the United States is 12,000.

In 2000, a dedicated passing lane for buses was implemented at each station stop inside Bogotá's Trans Milano system. Moreover, expedited services were implemented inside the BRT system. Consequently, the BRT's capacity escalated to 35,000 people per hour. In contrast, light rail may operate at speeds between 3,500 and 19,000 kilometres per hour, mostly on roadways. "The findings indicate insufficient evidence to substantiate the claim that light rail transit (LRT) can accommodate a greater capacity than busways." In comparison to BRT, LRT has many distinct advantages. Due to these conditions, the corridor must have one lane in each direction, accommodate over 16,000 people per hour in each direction, but less than 20,000, and the block length must exceed 20,000. Furthermore, the train must not obstruct intersections. Although uncommon, light rail would provide a substantial operational benefit in this context.

6. Conclusion:

This paper presents an overview of the BRT infrastructure and operations in India. Nonetheless, not all BRT components are common across the majority of the assessed BRT systems. Selecting the components of a BRT system must align with the project budget, the local user demographics, and the specific traffic and corridor conditions. These components must be integrated to get the maximum degree of passenger appeal and operational velocity. The characteristics of the BRT have been categorized into three implementation stages to address the limited success and ridership in Indian cities, along with the substantial expense of the right-of-way. A link exists between the proposed adjustments in various stages and enhanced positive effects on ridership attractiveness and operational speed. The advancement of these enhancements is marked by escalating costs, technical intricacy, and duration of execution. To assure the feasibility of a BRT system, the stages may be executed concurrently.

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