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Research Article

Navigating Dhule's Future: A BRTS Estimation Survey for Urban Mobility

[a]Basweshwar S. Jirwankar, [b]Darshankumar Patel

1,2,Assistant Professor, Department of Civil Engineering, SVKM's Institute of Technology, Dhule, 424001, Maharashtra, India

Corresponding Author Email b.s.jirwankar@gmail.com

Abstract: India's rapid urbanization and economic growth have led to traffic congestion, pollution, and challenges in its cities. With a surge in private vehicles, urban planners are designing mass rapid transit systems to ensure safe and environmentally friendly mobility. Dhule, a smart city, is exploring measures to encourage public transportation, with Bus Rapid Transit Systems (BRTS) emerging as the most suitable mode for a mass transit system. This research project aims to analyze the existing transportation system in Dhule and the proposed BRTS system. A preference survey is being conducted to assess commuters' willingness to shift from their current mode of transport to the BRTS. Urban transport modeling, consisting of four steps, is used to predict travel patterns and evaluate pre- and post-BRTS implementation scenarios using a transport ecological footprint analysis.

Keywords: Sustainable transport modes, Bus rapid transit system, Stated preference survey, Mode shift, Transport ecological footprint.

1. Introduction (Times New Roman 10 Bold)

The rapid urbanization and economic growth in India have exerted significant pressure on cities across the country, leading to issues like traffic congestion, pollution, and other related challenges. While large cities witness a surge in private vehicles, medium and small cities grapple with informal sector-provided intermediate public transport. In response to these urbanization challenges, the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) was launched in 2005, aimed at promoting sustainable service enhancements in urban agglomerations with populations of one million or more. This initiative includes the introduction of the Bus Rapid Transit (BRT) System. JNNURM is overseen by the Prime Minister's Office, the Ministry of Finance, and the Ministry of Urban Development, in collaboration with eligible state and local governments for project funding. Drawing heavily from the National Urban Transport Policy, the mission advocates for investments in infrastructure and the reform of Road Transport Corporations (RTCs). The primary objective is to establish rapid transit networks in major Indian cities, with BRT as the central mode for cities with populations under one million. For cities exceeding five million people, rail-based technologies are recommended.

Sustainable transport systems are designed to reduce emissions, lower fossil fuel consumption, and minimize land usage while ensuring accessibility for the public. Prioritizing public transit, cycling, and walking plays a pivotal role in sustainable development. The Bus Rapid Transit System (BRTS) is increasingly adopted by cities seeking cost-effective transit solutions and addressing environmental concerns. The concept of an ecological footprint has gained prominence in the context of sustainable development. It calculates the resource consumption and waste assimilation requirements of a specific human population or economy in terms of the corresponding productive land area. This ecological footprint can be integrated into transport planning to regulate transport activities that have detrimental effects on the environment.

2. Significance of the Study

Dhule city is currently grappling with a decline in the quality of its public transit services, which has led to a notable increase in the use of motorcycles and auto-rickshaws. These modes of transportation have become the primary contributors to motorized travel, with buses being relatively scarce. Additionally, the city has experienced a reduction in national highways and relies on a railway connection between Dhule and Chalisgaon. To alleviate traffic congestion and enhance travel comfort, efforts are being made to establish industrial estates. In light of the need to reduce energy consumption and emissions, it is imperative to prioritize sustainable transportation modes, including public mass transit and non-motorized transport. The study also investigates the travel patterns of the urban poor and evaluates whether the Bus Rapid Transit System (BRTS) caters to their accessibility requirements. The research is primarily focused on analyzing the shift from existing modes of transportation to BRTS in its initial and subsequent phases.

To alleviate traffic congestion and the heavy usage of the Central Bus Stand, Deopur has recently established a new bus stand. This new facility manages 120 daily routes and is linked to the Central Bus Stand through a fleet of four 25-seater mini-buses. In July 2016, city-bus services were inaugurated for four routes, connecting Laling to Nagav, Fagne to Morane, Walwadi to Vadjai, and CBS to ChakkarBardi.

The decision to adopt the Dhule Bus Rapid Transit System (BRTS) was motivated by several factors, including its excellent connectivity to the metropolitan city and its surrounding areas, the availability of ample raw materials and a skilled workforce, its proximity to Dhule Airport, and its location within the major river basin of the Tapi River. Traditional development models view Dhule as engines of economic growth, with transportation playing a supporting role in facilitating economic activities.

3. Review of Related Studies

Urban form encompasses various elements that define its characteristics and ongoing activities, primarily characterized by an integrated land-use pattern and its connectivity, established through transportation links. Consequently, there exists a wide array of urban forms, spatial structures, and associated urban transportation systems. Urban transport falls into three general categories: collective, individual, and freight transport (Rodrigue et al., 2006). In many cases, these categories complement each other, but at times, they may compete for the utilization of available land and transport infrastructure:

1. Collective Transport (Public Transit): Collective transportation aims to provide publicly accessible mobility within specific parts of a city. Its effectiveness depends on moving large numbers of people and achieving economies of scale. Modes of collective transport include tramways, buses, trains, subways, and ferryboats.

2. Individual Transport: This category encompasses modes where mobility results from personal choices and means, such as automobiles, walking, cycling, and motorcycles. While walking is the primary mode for basic mobility for most people, the prevalence of this mode varies depending on the city in question.

3. Freight Transport: Since cities are central hubs of production and consumption, urban activities involve substantial freight movements. These movements are typically characterized by delivery trucks traveling between industries, distribution centers, warehouses, and retail operations, as well as between major terminals such as ports, railyards, distribution centers, and airports.

In recent times, the Bus Rapid Transit (BRT) concept is gaining popularity as cities seek cost-effective transit solutions. BRT systems are designed with the aim of efficiently and affordably moving people, prioritizing public transit over private vehicles. BRT systems aim to rectify the shortcomings of previous public transport systems by providing a swift, high-quality, safe, and secure transit option. Key characteristics of BRT systems, as outlined by Wright (2002), include:

- Segregated busways
- Swift boarding and alighting processes
- Clean, secure, and comfortable stations and terminals
- Efficient fare collection before boarding
- Clear and prominent signage with real-time information displays
- Transit prioritization at intersections
- A strong focus on delivering excellent customer service

4. Objectives of the Study

- To delineate the existing urban transportation system and characterize the travel patterns of residents in the study area.
- To evaluate the potential mode shift towards the proposed Bus Rapid Transit (BRT) system by considering people's willingness to change modes based on predefined mode choice variables.
- To utilize the transport ecological footprint as an indicator to assess the sustainability performance of the pre- and post-BRT implementation scenarios.
- To analyze and visually represent the calculated transport ecological footprint.
- To pinpoint potential open areas suitable for constructing a bus stop within the Dhule Bus Rapid Transit System (BRTS).
- To examine the current traffic conditions in Dhule City.
- To formulate the alignment for the BRTS routes by assessing various parameters.

5. Hypotheses of the Study

In response to the heavy usage of the Central Bus Stand and increasing traffic congestion within the city, a new bus stand was constructed in Deopur, which commenced operations on March 23, 2015. Approximately 120 route buses operate daily from this bus stand. To connect the Central Bus Stand with the Deopur Bus Stand, four 25-seater mini-buses provided by MSRTC are utilized. These mini-buses run between the Central Bus Stand and Nagav, as well as between the Deopur Bus Stand and Laling. In light of the city's ongoing expansion and growing population, Shri Annasaheb Misal (IAS), The Collector & District Magistrate of Dhule, and Shri Rajendra Deore (Dhule Depot Controller) of MSRTC initiated city-bus services in July 2016. These services are available on four

distinct routes, including Laling to Nagav, Fagne to Morane, Walwadi to Vadjai, and CBS to ChakkarBardi. Conventional development paradigms view Dhule city as an "engine of growth," with urban development serving as a means to achieve this objective, and transportation playing a supporting role to ensure the necessary level of economic activity.

Several reasons support the selection of the Dhule Bus Rapid Transit System (BRTS):

- Its strategic location near the intersection of NH-6, NH-3, and NH-211 grants it excellent connectivity to metropolitan cities and hinterlands.
- With ample raw materials and a skilled workforce, this region exhibits significant potential for establishing manufacturing units specializing in textile products.
- Dhule Airport, known as "Gondur," is also in close proximity to the proposed region.
- The area is situated within the major river basin formed by the Tapi River.

6. Methodology

The methodology for implementing a Bus Rapid Transit System (BRTS) in Dhule City involves several key steps. Below is an outline of the methodology for establishing the BRTS system in Dhule:

1. Feasibility Study: The first step is to conduct a comprehensive feasibility study. This study should assess the city's current transportation system, traffic patterns, and the demand for improved public transit. It should also evaluate potential routes, station locations, and infrastructure requirements.

2. Route Planning: Based on the feasibility study, identify the most suitable routes for the BRTS system. Consider factors like population density, major destinations, and traffic congestion. Plan the BRTS routes to serve the maximum number of commuters efficiently.

3. Infrastructure Development: Develop the necessary infrastructure for the BRTS system. This includes dedicated bus lanes, elevated platforms for passengers, and modern bus stations. The infrastructure should prioritize safety, accessibility, and user convenience.

4. Fleet Procurement: Procure a fleet of buses that are compatible with the BRTS system. These buses should be eco-friendly and equipped with the technology required for efficient BRTS operation.

5. Traffic Management: Implement traffic management measures to ensure that the dedicated BRTS lanes are used exclusively for BRTS buses. This may involve lane segregation, signal prioritization, and strict enforcement of traffic rules.

6. Station Design: Design BRTS stations with clear signage, real-time information displays, and facilities for passenger comfort. Stations should be strategically located for easy access by commuters.

7. Ticketing and Fare Collection: Establish an efficient ticketing and fare collection system. Consider contactless smart cards, mobile apps, or other convenient methods to streamline the boarding process.

8. Operational Plan: Develop an operational plan for the BRTS system. Define schedules, routes, and procedures for maintenance and upkeep of the buses and infrastructure.

9. Public Awareness and Education: Launch a public awareness campaign to educate residents about the benefits of the BRTS system and how to use it. Encourage people to make the shift from private vehicles to the BRTS.

10. Testing and Launch: Prior to the official launch, conduct a testing phase to ensure that all components of the BRTS system are functioning correctly. After successful testing, launch the BRTS system to the public.

11. Monitoring and Evaluation: Continuously monitor the performance of the BRTS system. Gather data on ridership, passenger satisfaction, and operational efficiency. Use this data to make improvements and adjustments as needed.

12. Expansion and Integration: As the BRTS system gains popularity, consider expanding routes and integrating with other modes of public transportation, such as feeder buses or bicycle-sharing programs.

13. Sustainability and Environmental Considerations: Promote sustainability by ensuring that the BRTS system is eco-friendly, with a focus on reducing emissions and improving air quality.

The successful implementation of the BRTS system in Dhule City requires collaboration among various stakeholders, including government authorities, transportation agencies, and the public. Additionally, strong project management, effective budgeting, and public support are critical components of a successful BRTS project.

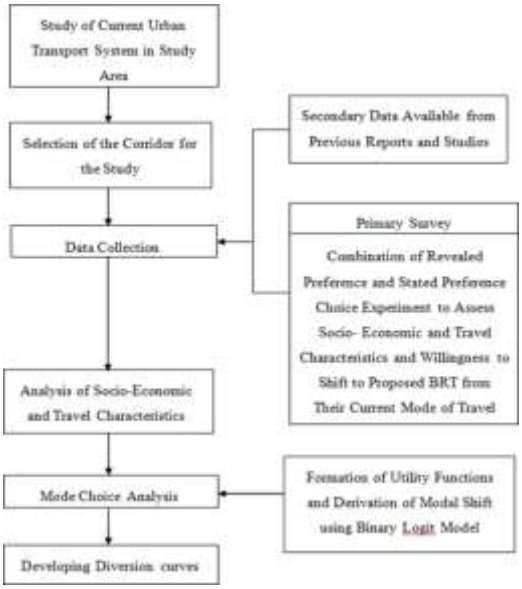

Fig. 1. Flow chart of Methodology

6.1. Study Area and Data Collection

The Dhule Bus Transit System (BRTS) strives to create a high-quality, high-capacity public transportation network designed to provide fast, convenient, and cost-effective urban mobility for its passengers. The BRTS program coordinates enhancements in the infrastructure, vehicles, operations, and technology of the transit system. It aims to ensure smooth traffic flow throughout Dhule City by assessing various factors such as accessibility, comfort, reliability, fare structure, travel duration, safety, and customer services.

The Institute for Transportation and Development Policy (ITDP) conducted a thorough examination of shared auto-rickshaw and Maharashtra State Road Transport Corporation (MSRTC) routes. The assessment included conducting traffic counts, frequency-occupancy counts, and parking surveys across the city to gain a comprehensive understanding of the existing traffic conditions. In addition to these field activities, interviews were conducted with key agencies, including the Nashik Municipal Corporation (NMC), MSRTC, the Regional Transport Office, and the Traffic Police. This research also involved an extensive analysis of agency-provided datasets.

Fig. 2 Study Corridor

Table Number 1. Percent of cases willing to shift to BRT with respect to income levels

Income Ranges in Rs.	**Total No. of Samples**	**Ca Willing to shift to BRT**	
		No. of Cases	**%age**

No Income (student)	90	46	51.11
> 60,000	39	6	15.38
40,000-60,000	34	5	14.74
20,000-40,000	335	83	24.77
10,000-20,000	695	242	34.82
5,000-10,000	627	266	42.42
< 5,000	180	57	31.66
Total	2000	705	35.25

The data presented in Table 2 indicates that a higher percentage of males are inclined to switch to the Bus Rapid Transit (BRT) system compared to females. Table 3 provides insight into the willingness to make this shift based on the current mode of transportation, and Figure 4 visually represents this information. Among current commuters, 23.73% of motorcycle users and 13.14% of car users expressed their intention to use the BRTS for their future journeys. A noticeable shift is also evident from bicycle users, amounting to approximately 7.69%. The most significant transition is observed among bus passengers, reaching around 70.87%. It is assumed that all bus users will transition to the BRT by default, as the BRTS system will entirely replace the existing City Bus service along Route 1, and the BRT fare is generally similar to that of the City Bus. Following closely is the auto category, with a substantial shift of about 58.15%.

Table Number 2. Percent of cases willing to shift to BRT with respect to gender

Gender	**Total No of Samples**	**Cases willing to shift to BRTS**	
		No. of Cases	**Percentage**
Female	497	165	33.19
Male	1503	540	35.76
Total	2000	705	35.25

Table Number 3. Percent of cases willing to shift to BRT with respect to current mode

Mode	**Total No. of Samples**	**Cases willing to shift to BRT**	
		No. of Cases	**Percentage**
Car	175	23	13.14
Two-Wheeler	1083	257	23.73
Auto	595	346	58.15
Bicycle	26	2	7.69
Bus	103	73	70.87
Walk	18	4	22.22
Overall	2000	705	35.25

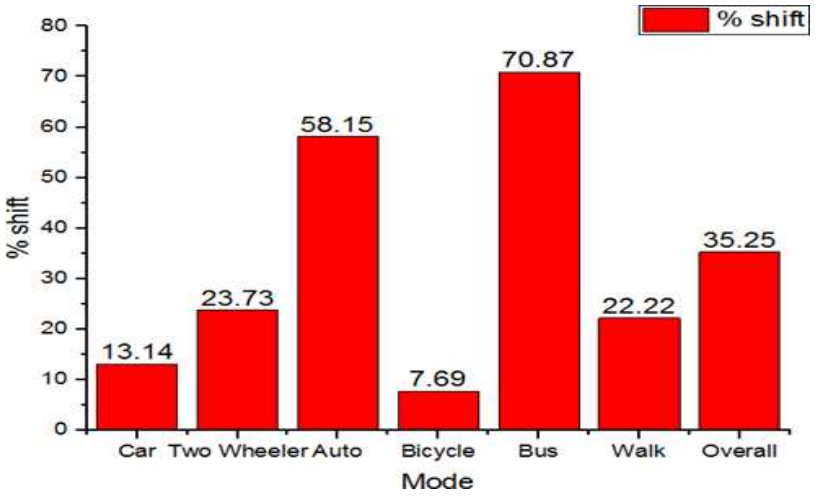

Figure No. 3. Percent of cases willing to shift to BRT from current mode

6.2. Developing Diversion Curves from Binary Logit Models

The diversion curves provided were obtained using the following model: UBRT – UMC = -2.618 - 0.043(DTT) - 0.156(DTC) + 1.318(comfort). Figure No. 4 illustrates the transition of motorcycle users to the non-AC Bus Rapid Transit System (BRTS). Each curve on the graph corresponds to varying differences in travel time values and a constant difference in travel cost values between the two modes, as indicated in the graph's legend. Since these curves pertain to the non-AC BRTS environment, a comfort value of 0 is assigned.

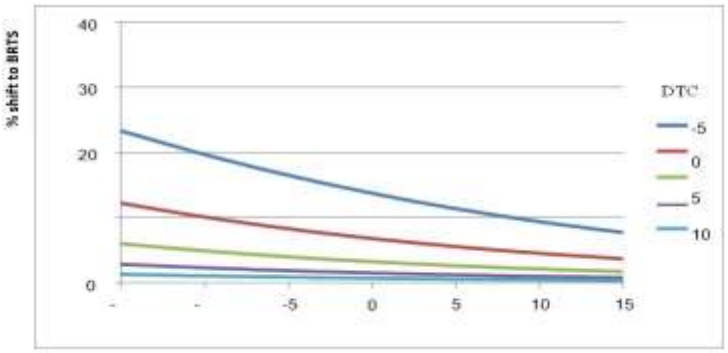

Figure No. 4. Diversion curves for Motorcycle and Non-AC BR

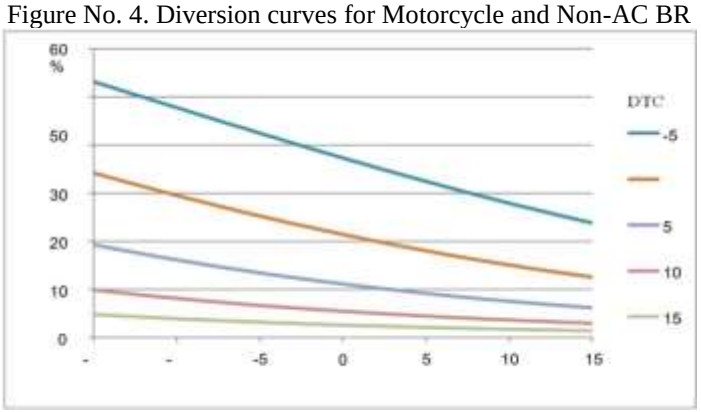

Figure No. 5. Diversion curves for Motorcycle and AC BRTS

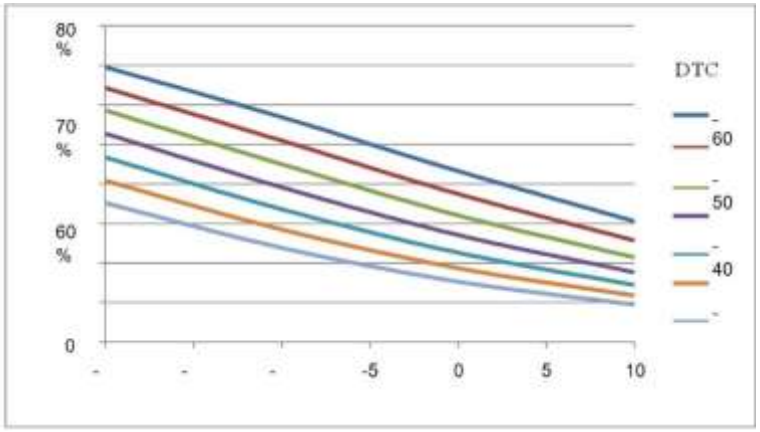

Figure No. 6. Diversion curves for Car and BRTS

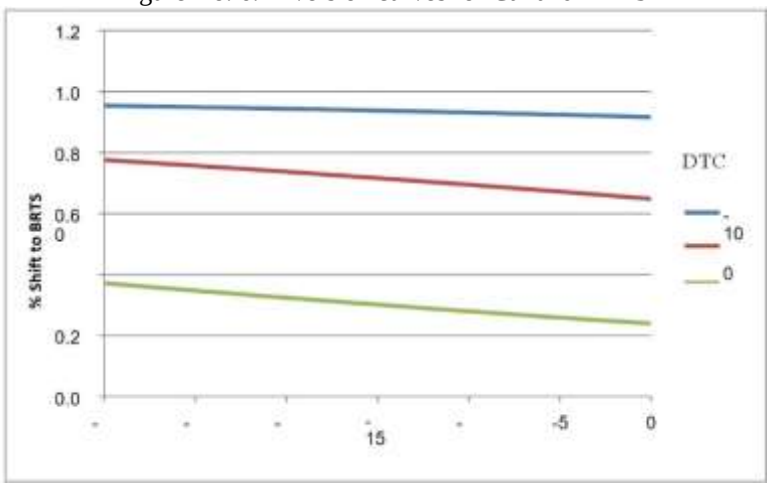

Figure No. 8. Diversion curves for Auto and BRTS

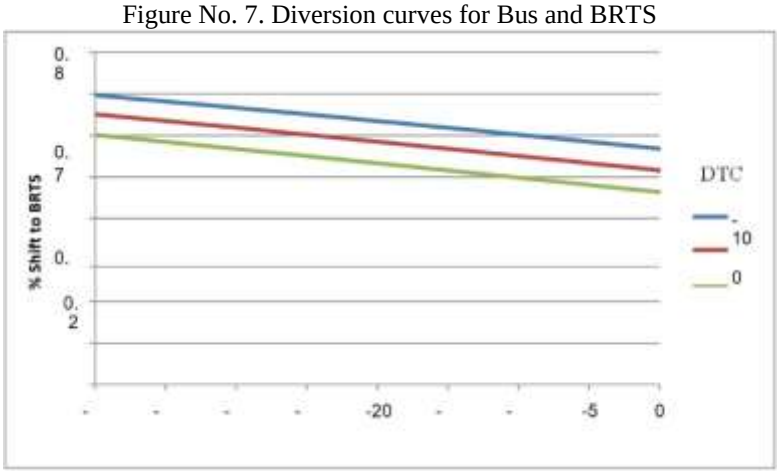

Figure No. 8. Diversion curves for Auto and BRTS

The study identifies a relationship between socio-economic characteristics and travel preferences. The majority of the sample population falls into the middle-income category, and motorcycles are the most commonly used mode of transport. Students predominantly choose public transit, with buses being their preferred mode. Shopping trips tend to be longer in duration compared to work and educational trips.

The results of mode choice experiments indicate that 35.25% of commuters are open to switching to the Basic Rapid Transit System (BRTS). Within this group, low-income individuals, males, students, and current bus users are more inclined to opt for BRTS. The models for motorcycle and BRT, as well as bus and BRT, exhibit a good fit, whereas the models for car and BRT, and auto and BRT, have R-squared values of 0.128 and 0.017, respectively.

Analysis of the diversion curves reveals that an increase in travel time and cost savings encourages more people to consider shifting to BRTS. BRTS with air-conditioning is more likely to attract passengers.

6.3 Urban Transport Developing Strategy and City Plan

In 2006, Dhule City formulated the Dhule Development Plan (DDP) 2020, a comprehensive document that encompasses various aspects of Dhule, including demographic and economic characteristics, land use, infrastructure, environment, housing, and slum areas.

1. The plan provides insights into Dhule City's demographics. According to the 2001 census, Dhule experienced an astonishing 40% population growth, with slum areas coexisting alongside sparsely populated regions, primarily near the city's periphery.

2. The plan outlines the population density, which stands at 200 persons per hectare in the Dhule planning area.

a) Water supply is accessible for only 45 minutes every alternate day, serving 54% of the city's population. The average water supply is 80 litters per capita per day (lpcd). However, 50% of the water is unaccounted for (UFW), including 40% attributed to transmission and distribution losses.

b) Merely 55% of the population has access to the sewerage network, and 80% of the sewer lines remain underutilized due to a lack of maintenance.

c) Only 20% of the roads have proper storm water drainage facilities.

d) Solid waste collection faces challenges due to inadequate handling and management practices.

3. Dhule City grapples with narrow road widths, high vehicle ownership, and a diverse mix of transportation modes, resulting in traffic congestion issues and a high rate of accidents.

6.4 Dhule city BRTS Design requirements

The Dhule City Bus Rapid Transit System (BRTS) incorporates several design elements aimed at creating an efficient, reliable, and sustainable public transportation network. These design elements include:

- Dedicated Bus Lanes: BRTS features dedicated bus lanes separate from regular traffic to ensure smooth and uninterrupted bus movement. These lanes are typically physically separated by barriers or markings.
- Bus Stations: BRTS stations are strategically located along the dedicated bus lanes and are designed to allow easy boarding and alighting of passengers. They are equipped with features such as shelter, seating, real-time information displays, and ticketing facilities.
- Pre-Board Fare Collection: Fare collection is typically done before passengers board the bus to expedite the boarding process. Passengers can purchase tickets or use smart cards at the station or online.
- High-Capacity Buses: BRTS systems employ high-capacity buses that can accommodate a large number of passengers, reducing the need for multiple smaller vehicles and promoting efficiency.
- Intelligent Transportation Systems (ITS): ITS components like GPS and real-time tracking help monitor bus movements, provide accurate arrival times, and ensure efficient operations.
- Traffic Signal Prioritization: Traffic signal prioritization systems are implemented to give BRT buses priority at intersections, allowing them to pass through quickly and maintain schedule adherence.
- Integration with Other Modes: BRTS is designed to integrate seamlessly with other modes of transportation, including feeder buses, cycle-sharing systems, and pedestrian pathways.
- Accessibility: The system ensures accessibility for all passengers, including those with disabilities. Stations and buses are equipped with ramps and other features to accommodate wheelchair users.

7. Surveys done

7.1. TVCS

A traffic volume survey in Dhule City involves collecting data on the volume of traffic on various roads and intersections within the city. This data is essential for traffic management, infrastructure planning, and ensuring the smooth flow of traffic. A traffic volume survey is an essential tool for managing urban traffic and ensuring the efficient movement of people and goods within Dhule City. It helps in making data-driven decisions to improve the city's transportation infrastructure and overall quality of life for its residents.

Table 4. Traffic volume survey at 5 locations in Dhule

| Location/Intersection | Date/Time | Average Daily Traffic (ADT) | Peak-Hour Traffic | Vehicle Type Distribution |

|----------|----------|----------|----------|----------|----------|

| Location 1 | 01/01/2023| 10,000 vehicles/day | 1,200 vehicles/hour | Cars: 70%, Trucks: 20%, Motorcycles: 10% | Heavy morning traffic |

| Location 2 | 01/01/2023| 8,500 vehicles/day | 900 vehicles/hour | Cars: 60%, Trucks: 25%, Motorcycles: 15% | Frequent congestion |

| Location 3 | 01/01/2023| 6,000 vehicles/day | 800 vehicles/hour | Cars: 75%, Trucks: 15%, Motorcycles: 10% | School zone area |

| Location 4 | 01/01/2023| 12,500 vehicles/day | 1,400 vehicles/hour | Cars: 65%, Trucks: 20%, Motorcycles: 15% | Intersection upgrades planned |

| Location 5 | 01/01/2023| 9,200 vehicles/day | 1,000 vehicles/hour | Cars: 70%, Trucks: 18%, Motorcycles: 12% | Recent road expansion |

7.2 Feedback Survey

A traffic feedback survey is a method used to gather input, opinions, and feedback from individuals and communities about traffic-related issues and transportation systems. These surveys help transportation authorities, city planners, and policymakers make informed decisions and improvements to address traffic-related problems. The surveys may cover a wide range of topics related to traffic, such as road conditions, congestion, safety, public transportation, and more.

Table 5 Feedback survey

S. No.	Parameter	Not satisfied	Satisfied	Very satisfied
1	Speed	12.3	73.6	14.1
2	Reliability	15.1	21.4	63.3
3	Safety	15.7	18.1	66.1
4	Convenience	21.3	15.8	62.8
5	Frequency	19.8	30.8	49.3
6	Comfort	19.2	30.2	50.4
7	Cleanliness	17.3	25.9	56.6
8	Pedestrian crossing	54.9	35.3	9.7
9	Width of foot path	21.8	27.1	51.02
10	Over loading problem in I buses	20.7	27.7	51.4
11	I- bus is having reasonable fare	12.4	23.03	66.3
12	Overall Satisfaction	17.24	31.1	51.78

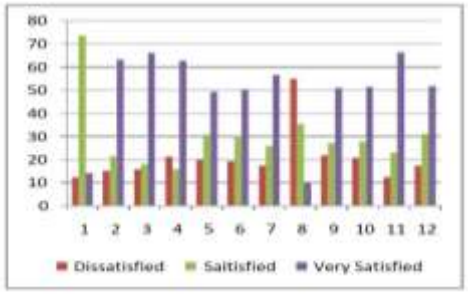

Fig. 9 Analysis of Feedback survey

7.3 Project Budget

Creating a budget for a Bus Rapid Transit System (BRTS) project can be a complex task that involves various components and considerations. Here is a simplified outline of some of the key elements to include in a BRTS project budget:

Infrastructure Costs:

- Bus stations and terminals
- Exclusive bus lanes or corridors
- Road and lane widening or modifications
- Pedestrian facilities and crossings
- Traffic management systems
- BRT-specific vehicles

Operational Costs:

- Vehicle maintenance

- Fuel and energy costs
- Employee salaries (drivers, maintenance staff, station personnel)
- Fare collection and ticketing systems
- Marketing and promotion

Technology and Communication:

- Intelligent transportation systems
- Passenger information systems
- Surveillance and security systems

Consulting and Planning:

- Feasibility studies
- Design and engineering services
- Project management

Environmental Considerations:

- Environmental impact assessments
- Sustainable and green features

Reserve Funds:

- Contingency fund for unexpected costs or delays

Public Engagement and Outreach:

- Public awareness campaigns
- Community engagement activities

Maintenance and Ongoing Costs:

- Routine maintenance of infrastructure
- Replacement of vehicles and equipment

Financing Costs:

- Interest and financing charges if borrowing funds

Insurance and Risk Management:

- Liability insurance
- Risk assessment and management

Monitoring and Evaluation:

- Performance monitoring and data collection

Miscellaneous Costs:

- Legal and regulatory compliance
- Land acquisition or property costs
- Safety measures

It is important to work with financial experts, project managers, and urban planners to create a detailed budget specific to the location and scale of your BRTS project. The actual budget will vary significantly based on factors such as the size of the system, the geographic location, and the existing infrastructure. Additionally, funding sources, whether public or private, will play a critical role in shaping the budget.

Table 6 Estimated Budget of Dhule BRTS

8. Conclusion

As India undergoes rapid urbanization and economic growth, its cities grapple with the challenges of traffic congestion, pollution, and increased private vehicle usage. In response, urban planners are seeking solutions in the form of mass rapid transit systems to provide safe and eco-friendly mobility options. Dhule, designated as a smart city, is no exception to this trend, and it is exploring avenues to promote public transportation. Among these, the Bus Rapid Transit System (BRTS) has emerged as the most suitable mode for a mass transit system in Dhule.

This project has undertaken a comprehensive analysis of Dhule's existing transportation system, as well as the proposed BRTS system. It aims to understand the current state of transportation and the potential impact of the BRTS. To achieve this, a preference survey is being conducted to gauge the willingness of commuters to shift from their current mode of transport to the BRTS.

The study also employs urban transport modeling, encompassing four essential steps, to predict travel patterns within the city. By evaluating pre- and post-BRTS implementation scenarios, the research employs a transport ecological footprint analysis. This approach provides a critical lens through which to assess the environmental impact and sustainability of the proposed changes in the city's transportation system.

In conclusion, as Dhule continues its journey towards becoming a smart city, the introduction of the Bus Rapid Transit System stands as a significant step forward in addressing urban mobility challenges. The research project endeavors to provide valuable insights and data-driven recommendations that can guide the city in achieving its goals of efficient, sustainable, and eco-friendly transportation systems. This holistic approach aims to enhance the quality of life for Dhule's residents and contribute to the city's overall development.

References (APA)

National institute of urban affairs ―Ahmedabad BRTS project report

Asia BRTS conference ―presentation on application of Intelligent Transport Systems‖.

Journal of Engineering Research and Studies E-ISSN 0976-7916

TCPR Report 90, "Bus Rapid Transit" USA (2002)

JNNURM,"DPR on INDORE BUS RAPID TRANSIT SYSTEM INDORE CITY TRANSPORT SERVICES LTD" INDORE (June 2006)

Gujarat Infrastructure Development Board, "Ahmedabad Integrated Public Transit System Report" Ahmedabad (august 2005).

S. Rokade* and S. Gupta *"Bus Rapid Transit System: An Analysis of Bhopal City".