Seamless Connectivity Through Integrated Transportation Modes For Panvel

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Abstract— ***Due to urbanization, population growth, outward city expansion, and increasing commuter demands, Panvel, a rapidly developing neighbourhood in Navi Mumbai, faces serious transportation challenges. Present and future mobility demands cannot be adequately met by the suburban rail, bus, and private vehicle services currently in place. In order to suggest a practical, effective, and ecologically friendly transportation network, this study focuses on the design and implementation of an Integrated Multi-Modal Transportation System for Panvel. On-site observations, surveys using Google Forms to gather commuter feedback, and evaluations of current transportation options, associated problems, and commuter needs are all incorporated in the study. A unified ticketing system, bike and pedestrian-only routes, and the incorporation of smart mobility solutions are among the recommendations made in the paper.***

***Index Terms*—Commuters Demands, Smart mobility solution , unified ticketing system, Pedestrian route**

1. INTRODUCTION

Panvel has emerged as one of the fastest-growing hubs for population and economic development in Navi Mumbai. This rapid growth has significantly increased the demand for efficient transportation, making it crucial to address existing challenges in the city's transport system. An in-depth assessment of Panvel's current transportation infrastructure reveals several shortcomings—such as inadequate roads, poor public transport services, lack of road-user discipline, and insufficient planning—which lead to heavy traffic congestion, high fuel consumption, increased air pollution, and poor service quality for commuters.

To meet the mobility needs of a growing urban population, it becomes essential to adopt advanced solutions like an Integrated Multi-Modal Transportation System (IMMTS). This approach combines two modes of transport—such as road and rail into a unified, coordinated network. By facilitating seamless connectivity for both passengers and goods under optimized contracts, IMMTS offers cost savings, improved efficiency, and enhanced routing flexibility. It helps overcome geographical constraints, maximize the use of existing infrastructure, and deliver smooth, uninterrupted travel experiences.

For rapidly urbanizing cities like Panvel, where private transport alone cannot meet the increasing travel demand, a mass rapid transit system integrated with other public transport options is no longer optional—it is a necessity. Implementing IMMTS can effectively combat road congestion, reduce travel time, minimize environmental impacts, and provide modern, high-quality transit services to meet the needs of urban commuters.

1.1 Urban Multimodal Commuting

1.1.1 Internal and External Roadways-By Road, Panvel is well-connected to all of the major cities. The city is now a major trade and transportation hub in the area since it is traversed by all of the major highways and railroads. The city is traversed by the following major roads. National Highway 4, which runs between Chennai and Delhi. It travels through seven states, passing through significant cities like Pune, Mumbai, Jaipur, and Ahmedabad.
Panvel revised and comprehensive Development plan 2024

- National highway 4C
- Pune -Mumbai Expressway
- Sion-Panvel Highway
- State Highway 54 connecting with Panvel and Matheran.

1.1.2 Bus Transport- In the PMC region, buses rank as the second most popular form of transportation, catering to government agencies such as BEST, NMMT, TMT, KDMT, and KMT. They offer feeder services to suburban railways as well as connectivity to far-off locations. Private automobile ownership rises in tandem with population growth, but public transportation has not kept pace. To curb the growth of private vehicles, public transportation must be expanded.
1.1.3 Railway- Panvel railway station is a bustling hub for daily commuters and long-distance travellers alike, serving as the terminus for the Harbour Line and a vital stop for various long-distance trains. However, with the city's rapid expansion,

overcrowding has become a significant issue, highlighting the need for more frequent train services and improved infrastructure. It's essential to modernize and expand Panvel's rail services to meet the transportation demands of the future.

1.1.4 Paratransit-The city's transportation system depends heavily on Panvel's paratransit vehicles, which include small vans, share taxis, and autorickshaws. They bridge the gap between passengers' final destinations and larger transportation systems by providing flexible, on-demand services. Paratransit continues to be an essential component of everyday commutes despite issues like traffic jams and fare disputes.

2. Benefits Of Multimodal Transport

- Shorter Travel Time: By coordinating bus, train, and other transportation schedules, waiting times are decreased, enabling quicker and more effective travel.
- Convenience: Passengers can move between modes of transportation (such as a metro to a bike-sharing program) without having to deal with acquiring multiple tickets or figuring out various systems.
- Effective First/Last Mile Communication: Multimodal solutions solve the "first/last mile" problem by combining mass transit systems with ride-sharing, cycling, or walking, which facilitates travel to and from transit hubs.
- Less Dependency on Private Vehicles: This lessens the need for car ownership, which lowers traffic and parking demand in urban areas. Sustainability of the Environment
- Reduced Emissions: Air pollution has increased as more people use public transit and environmentally friendly options like walking, bicycling, and electric buses.

3.Objectives

- To conducted field observations in Panvel.
- To Circulate a survey aimed to identify key transportation issues and gather relevant data on commuter response.
- The goal was to replace outdated traditional modes of transport and suggest alternatives mode of transportation for providing more efficient, eco-friendly, and accessible transportation options.

4.Problem statement

- The area's overall mobility is impacted by congestion, which is caused by heavy traffic on major roads, particularly during peak hours. This causes major delays for both private vehicles and public transportation.
- Insufficient Rail Access: It is challenging for commuters to depend on trains as their main form of transportation because the current rail network is frequently congested, offers few services, and operates infrequently.
- Inadequate Transportation Integration: When buses, trains, and autorickshaws don't connect seamlessly, commuters experience inconvenience, which lengthens travel times and increases annoyance.
- Inadequate Facilities: Roads, bus stops, and train stations are examples of transportation infrastructure that has not been adequately developed. This affects accessibility and safety and adds to the system's inefficiency.
- Increasing Demand and Population: Increasing urbanization
- Rising pollution levels from vehicular traffic and need for sustainable transport solutions highlight the challenge of balancing growth with environmental sustainability.

5.Literature Review

The paper discusses how shared mobility transforms urban transportation, emphasizing integrating ride-hailing services with public transit to alleviate congestion and improve accessibility. It focuses on the introduction of Integrated Multi-modal Transport Systems (IMMTS) to reduce congestion, improve accessibility, and enhance public transportation services across various urban transit modes The design and operation of last-mile services, particularly those that involve small-capacity vehicles such as vans and buses, are explored. It highlights how IMMTS can reduce reliance on personal vehicles, enhance public transit usage, and contribute to environmental sustainability and reduced congestion in urban areas. [1].

The paper highlights challenges in Indian cities, including high population density, poor land use planning, and inadequate transportation infrastructure. The study addresses the urgent need for sustainable transportation solutions in India. It focuses on introducing Integrated Multi-modal Transport Systems (IMMTS) to reduce congestion, improve accessibility, and enhance public transportation services across urban transit. The paper provides a framework for understanding the potential of Integrated Multi-modal Urban Transportation in India. It highlights how IMMTS can reduce reliance on personal vehicles, enhance public transit usage, and contribute to environmental sustainability and reduced congestion in urban areas. [2]

A high-quality standby environment provides high timeline information (highlighting, easy to access), Reliable phone information service, Advanced personal safety, Easy access to ticketing and pricing systems, and Access to Private public transmission services can be improved, especially in low-density rural areas. The availability of the destination's mode of transport can be improved, for example, by leasing the service, especially for areas with poor quality public transport services.[3]

The popularity of on-demand transportation options is rising due to increasing transit availability and the lack of automobile-ownership in segments of the population. These options include community-wide car and bicycle rental systems enabling users to rent vehicles by the hour. Demand for bike- and car-sharing services will grow as more and better transit options are developed, along with the accompanying increase in residential options close to the transit service.[4] The multi-modal network in Indore consists of a paratransit system- Maruti vans and TATA magic supplementing the primary system- BRTS; the system has a

majority stake in the paratransit system, with more than 60% of the travel taking place in the same. The waiting time considered in both routes is more than the BRTS due to the irregularity in the boarding process undertaken by the operators, which causes further delays. The fare per km in case of paratransit is unregulated and demands further revision. The provision for interchanges is found to be wanting. Only BRTS has proper stations for boarding and alighting.[5]

6.METHODLOGY

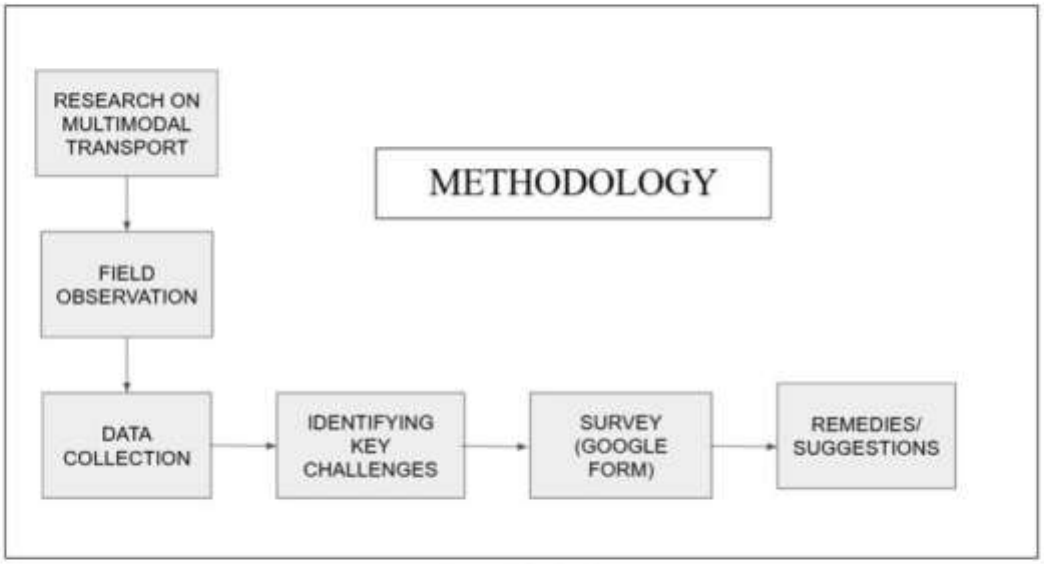


Fig. 1 Methodology

Table No. 1 Field Observation

SR NO	LOCATION	REMARK
1	Taloja Phatak, Kalamboli Link Road, Sector 23 Near Sahil Tyer Service	Signalization required
2	Kalamboli Circle, Sector 1	Grade separation recommended
3	NH-48, Roadpali, Kalamboli, Near Accentive India Pvt. Ltd.	Road capacity upgradation
4	NH-48, Sector 17, Greater Khanda, Near BBQ Maniac's	Future capacity expansion
5	Chhatrapati Sambhaji Chowk, Sector 1A, New Panvel East, Panvel	Traffic management required
6	FBB & Big Bazaar Square Near Panvel Railway Station	Infrastructure and flow improvement
7	NH-48, Forest Colony Near, Dr. Babasaheb Statue	Immediate signalization needed
8	Chhatrapati Shivaji Maharaj Square Near DTDC Courier	Capacity enhancement required
9	Bhaji Market Circle, Uran Road Near Shree Panchmukhi Hanuman Mandir	Presently within limit
10	Takka colony, NH-48, Old Panvel Mindseed Pre-School Near Road Safety Foundation	Presently within limit
11	Panvel-Kalyan Kalamboli Bridge Steel Market Road Near Axis Bank ATM	Upgradation needed

Table No. 2 Field Observation (Pedestrian Movement)

SR.NO	LOCATION	REMARK
1.	Near Kalamboli Bridge Close to Steel Market	Within permissible limit
2.	HDFC Circle Near Shear Khan New Panvel Flyover Road	Pedestrian phase required
3.	Bhaji Market Circle, Uran Rd, Old Panvel Near Bhaji Market	Provide signal and pedestrian phase
4.	Chhatrapati Shivaji Maharaj Square Near DTDC Courier	Pedestrian phase required
5.	Old Panvel Station Road in Front of Government Hospital	Provide skywalk to station
6.	NH-48, Sector 15, Old Panvel, Panve	Grade separated pedestrian facility
7.	NH-48, Roadpali, Kalamboli	Pedestrian phase required
8.	Junction near Panvel Railway Station East Parking	Proper pedestrian crossing
9.	Kalamboli Circle, Sector 1 Road, Sector 1, Kalamboli, Panvel	Pedestrian facilities with phase

7.SURVEY ANALYSIS

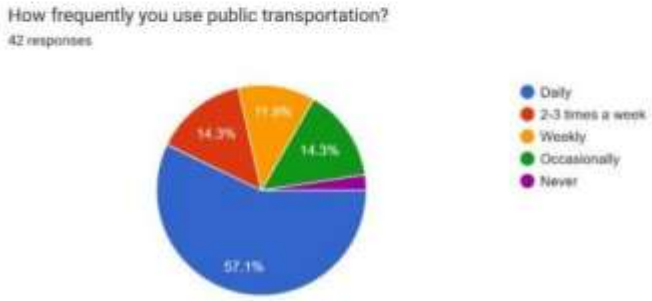
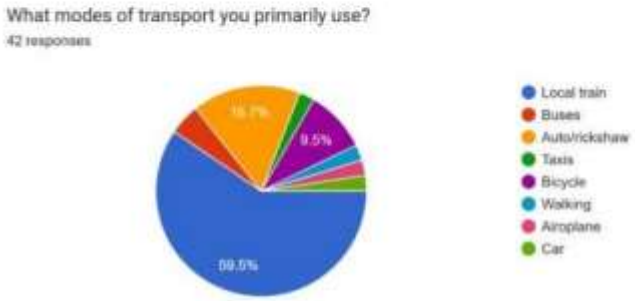


Fig. 2



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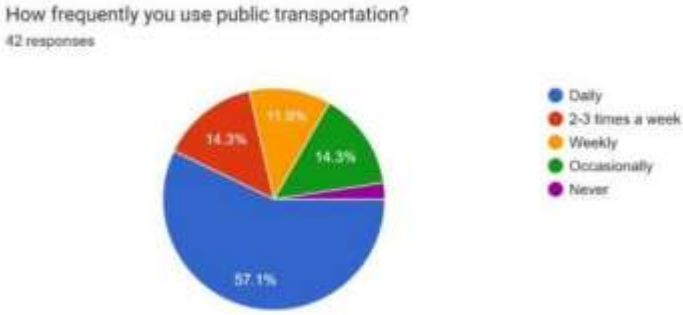

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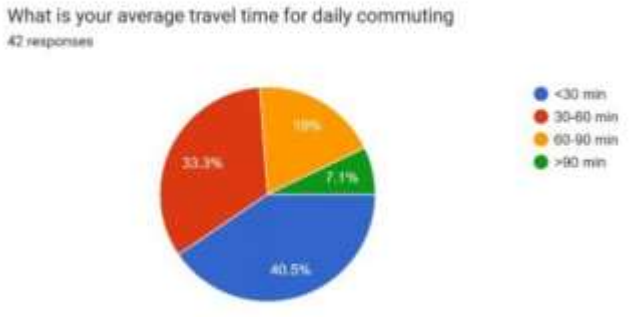

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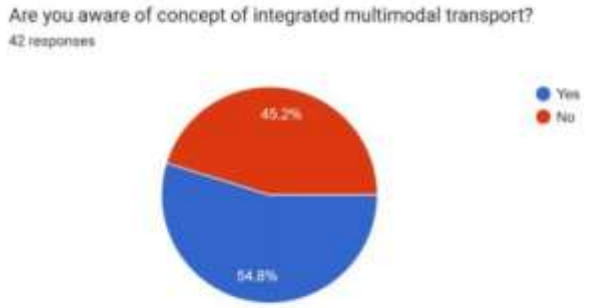

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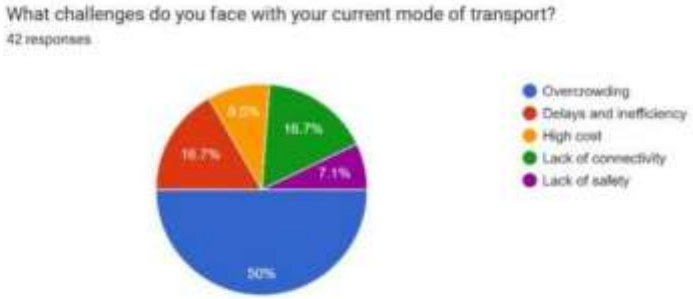

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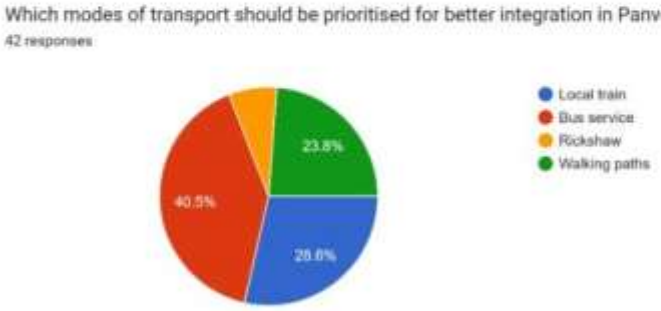

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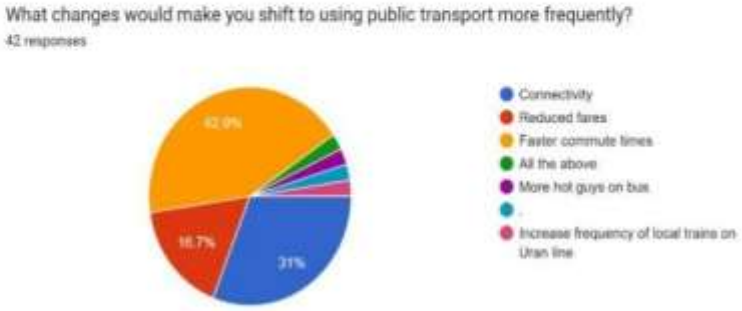

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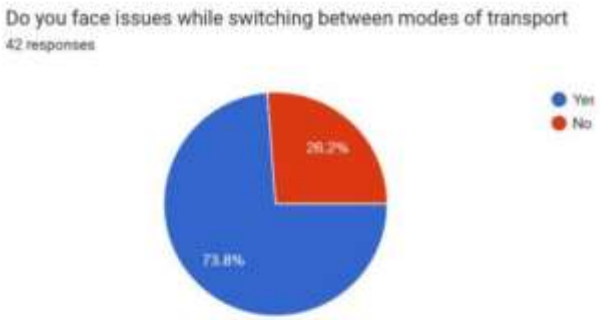

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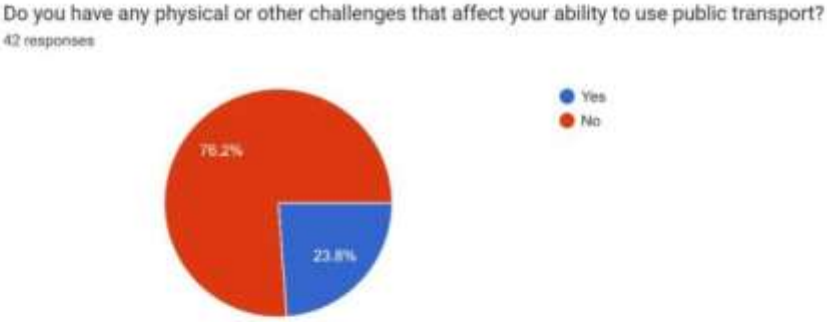

Fig. 11

8.Recommendation For Integrated Multimodal Transportation In Panvel

8.1 Unified Ticketing System

- Adopt a smart card or mobile application-based single ticketing system facilitating convenient travel via all modes (trains, buses, metro, rickshaws, taxis).
- Construction of Transport Hubs:
- Create multi-modal transit terminals at key points like Panvel Railway Station with local buses, rickshaws, and metro for free interchange.

Fig. 12

8.2 First and Last-Mile Connectivity Solutions:

- Improve first and last-mile connectivity by introducing bicycle-sharing services, e-rickshaws, and shuttle services from residential complexes to major transport nodes.

Fig. 13

8.3 Increase in Bus Routes:

- Enhance the frequency and coverage of bus services, especially in the suburbs, to minimize dependence on private transport.

8.4 Real-Time Information Systems:

- Install GPS-based real-time bus and train tracking systems whereby commuters can plan their trip better.

8.5 Bicycles and E-bikes

- Add bike-share stations near transit stops to provide first/last mile links.

Fig. 14

8.6 Parking and storage:

- Provide ample safe bicycle parking close to primary transit hubs.
- Bicycle and Pedestrian Infrastructure:
- Improve safety and convenience through expansion of dedicated bicycle facilities and design dedicated cycling paths and pedestrian walkways to promote non-motorized movement.
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8.7 Public Awareness Campaigns:

- Implement measures to educate residents about the benefits of adopting public transport and eco-friendly transport systems.
- Electric Vehicles (EVs) and Charging Infrastructure
- Transit hubs charging stations: Install EV charging stations in multimodal transfer stations.
- EV shuttles: Implement electric shuttles and buses to attain low emissions and noise pollution.

Fig. 15

9. Conclusion

A transportation framework that can address present issues and get ready for future mobility demands is necessary given Panvel's rapid growth. Through the seamless integration of rail, bus, paratransit, bicycle, and pedestrian networks, an Integrated Multi-Modal Transportation System (IMMTS) provides an effective and sustainable solution. The suggested tactics, which range from feeder services, multimodal hubs, and intelligent traffic control to the use of green energy, can greatly lessen traffic, increase accessibility, and improve the commuter experience. Coordinated public, private, and governmental efforts, backed by progressive legislation and significant infrastructure investments, will be necessary for successful implementation. By adopting IMMTS, Panvel can establish itself as a model for intelligent, sustainable urban transportation in India, striking a balance between social justice, environmental responsibility, and growth.

10. References

[1] Arvind U. Raghunathan 'Seamless multimodal transportation scheduling' TR2023-076 July 04, 2023

[3] Nishant Kumar Shrivastava 'Design of multimodal integrated transportation' IJSDR - International Journal of Scientific Development and Research July-2019,

[4] Kristine. M. Williams 'Multimodal transportation best practices and modal element' Florida Department of Transportation

[5] Jitendra Jain 'Multimodal Public transportation system- Indore case study September 2015

[6] Buchari, Erika et al. (2008). Enhancing Public Transport System in Developing Countries towards Multimodal Public system proceedings of the Conference on The Intelligent Public Transport System, April 2-4, Netherland.

[7] Hine, J. and Scott, J. (2000). Seamless, Accessible Travel: User's Views of Public Transport Journey and Interchange.

[8] Kumar, P. (2009), Design Approach for Multi Modal Transport System. Architecture - Time Space & People

[9] Litman, T. (2012), Introduction to Multi-Modal Transportation Planning, Victoria Transport Policy Institute

[10] Singhal, B. I. 2010. Towards Sustainable Urban Transport in India. 2010.

[11] Verma, A., (VOL. 100, NO. 9, 2010). Achieving sustainable transportation system for Indian cities. CURRENT SCIENCE.