Management of Transportation Resources in Urban Areas

Saurabh Dilip Gaikwad[1] Prof. S. S. Ambure[2]
[1]M. E. Student [2]Assistant Professor
[1,2]Department of Civil Engineering
[1,2]Padmabhooshan Vasantdada Patil Institute of Technology (PVPIT), India

Abstract— The modern world has become aware and used to all the technological developments and the repercussions due to these developments. Thus, we need to find ways to use all these technological advancements with optimum utilization of all the resources and doing minimal harm to the environment with proper management of resources. We are thus going to study management of transport resources in Nashik city. Firstly, we would study the previous analytical as well as statistical data regarding the transportation system in Nashik and thus potentially analyze the data. This data is then going to be compared to the present statistical data which is going to be collected by myself with the help of 'NASHIK MUNICIPAL CORPORATION'. Thus the drawbacks or irregularities of the previous data will be jotted down and thus pondered upon for further improvements. The major goals for this project by overall study is improving the overall safety aspect by reducing the overall fatalities from crashes or public transport and improving the public transport by whatever feasible means we can. The major aim would be improving the increasing the public transport accessibility and also a major stress would be given on keeping the pollution levels of the city low as Nashik is a bliss and we do want to keep it the same.

Keywords: Optimum, Management, Transportation, Fatalities, Accessibility

I. INTRODUCTION

We, today, live in a built environment which suffers from the spatial side effects of technological overdose that has been administrated in hurry. The faceless uninspiring architecture, blood pressure increasing traffic conditions, lungs hollowing pollution, social interaction discouraging housing areas tension creating psychos cape, crime, corruption prone city sphere the filth clogged wings of birds the oxygen gasping creature are some of the consequences of the indiscriminate technology application in pursuit of short term economic goals to attend civilization which we call cities. Some the key urban problems that are worldwide in their character and severity basically due to both expansion of population and physical expansion of the cities. The developing world's cities have their characteristic problems. The explosive increase in population, gross inadequacy of infrastructural facilities and services, overcrowding and traffic jams, ribbon development, crumbling old city centers, urban blight, neighborhood degradation, expansion of slums and spontaneous settlements, insanitary backyards and public places etc., culminating in an urban crisis, are characteristics of the cities of developing countries. The rising demand for infrastructure services is directly related to the increasing population, GDP growth and rising per capita usage of infrastructure services associated with increasing incomes as per basic and theoretical studies. The gap between demand and supply, and the inaccessibility and unaffordability of services and infrastructure to segments of the population, represents a major weakness in policy, planning approaches and institutional capacity. Hence, there is a need for more innovative and inclusive business models, especially models which can more effectively mobilize finance for investment and which can involve the private sector and community groups in the financing and management of services. Nashik is the third largest urban area in the state of Maharashtra. According to the 2011 census, Nashik has a population of 1.48 million. With increasing migration to urban areas, Nashik's population is estimated to rise to nearly 4 million by 2030. The city is witnessing rapid motorisation, along with increased congestion and pollution. Presently, most public transport in Nashik comprises bus services operated by the Maharashtra State Road Transportation Corporation (MSRTC). The remaining trips are made via privately owned and operated shared autorickshaws. None of the public transport modes are of a high quality. Buses are overcrowded during peak hours and their speed is dropping by the day due to traffic congestion. As a result, the number of personal motor vehicles is growing at a brisk pace of 7 per cent per annum. If this growth continues, we estimate that the number of trips made by personal motorised modes will double over the next 10 years. Accommodating this increase in personal motor vehicle use will be difficult. Even if all of Nashik's main roads are transformed to include elevated corridors on top, there won't be enough capacity to meet 2023 demand. Transport planners have increasingly come to a consensus that successful cities facilitate the movement of "people, not vehicles," which is a goal clearly expressed in the National Urban Transport Policy (NUTP). In support of the NUTP, the Nashik Municipal Corporation (NMC) recognizes that public transport and urban accessibility are drivers of growth and prerequisites for quality of life. NMC should choose to create a sustainable, robust, high-capacity mass rapid transport system (MRTS). Such as system must accommodate the anticipated 2023 demand and be expanded for future growth over the following two decades. Through strategic public transport and allied interventions, we aim to achieve the following goals over the next 5 years (2019-2023):

- Improve public transport: 35% of all trips by public transport
- Support non-motorized transport (NMT). Maintain existing share of all trips by cycling and walking (38%)
- Improve safety. Zero fatalities per year from traffic crashes
- Public transport accessibility. 75% of residents within a 5 min walk of formal public transport
- Keep Nashik air healthy. Zero nonattainment days for PM and NOX emissions.

Nashik stands at a crossroad in its history and development. With suitable urban interventions at this stage, it can avoid the pitfalls of cities of similar characteristics and can set high standards for other cities to follow. The city has the potential to become a global commercial and cultural

centre that affords its citizens immense benefits in the form of jobs, opportunities, and improved quality of life. For this opportunity to become a reality, the city will have to develop adequate infrastructure and services to facilitate development and improve the quality of life of all its citizens, both rich and poor.

A. Overview of the City: Nashik

Nashik is one of India's oldest cities, finding mention in ancient Indian literature of the pre-Christian era. The Archaeological Survey of India cites evidence of continuous habitation from around the fifth century B.C. Located about 24 km from the headwaters of the Godavari River (plentifully mentioned in Ramayana and Mahabharata), Nashik has long been an important religious centre, attracting millions of pilgrims, and every 12 years hosting one of the world's largest gatherings, the Kumbhmela (which estimated to have brought 100 million visitors over the course of 55 days in August-September 2015).Nasik today is a tremendously busy industrial centre. Well connected by road and rail, Nashik lies on Delhi-Mumbai industrial Corridor. Nashik's key industries are localized near the villages of Ambad, Satpur, and Sinnar on the Pune highway. Nashik is home to engineering and medical colleges. It is the highest producer of grapes and onions and hosts over a third of India's wineries. Around 48 lakh tourists visit Nashik annually for wine tourismNashik is the fourth largest city, and third largest urban area, in the western Indian state of Maharashtra. According to the 2011 census, Nashik has a population of 1.48 million. Nashik's population is set to grow to nearly 4 million by 2030. With increasing population, the city is witnessing rapid motorisation, increased congestion and pollution. With suitable interventions at this stage, it can avoid the pitfalls of cities of similar characteristics and can set high standards for other cities to follow. Nashik has a population density of 42 persons per hectare, indicating that there is potential to increase densities and achieve a more compact city form as the city grows. The Nashik Municipal Corporation (NMC) is the authority responsible planning and service provision for the Nashik Metropolitan Area. Headed by a Municipal Commissioner, NMC utilises eleven departments to carry out civic operations. NMC's Roads and Building Department is responsible for maintenance of Nashik's 1,049 km of roads as well as its schools, public toilets, community temples and health clubs. The Town Planning Department is responsible for the planning activities, including sanctioning plots for construction, identifying encroachments based on complaints, sanctioning Transfers of Development Rights, and preparing survey maps. Town Planning manages the reserved buildings and land, and is the decision making body regarding how land is allocated for various purposes.

B. Prior Transportation Study of the City

A Comprehensive Mobility Plan (CMP) was carried out in 2007 for Nashik to identify transport interventions for the city. The CMP included a survey of 3,500 households (1.4 per cent of the population) and traffic counts at seventeen locations. The CMP found that non-motorised and public The CMP identified the following issues concerning Nashik's transport system:

- Poor pedestrian infrastructure.
- Limited public transport services and low public transport mode share.
- Lack of effective parking management mechanisms.
- Environment deterioration due to motorised traffic.
- A lack of connectivity across the river results and bypass routes for freight movement result in increased traffic in the city centre.

In response to these issues, the CMP proposes almost 90 km of public transit corridors on ten routes in the city, including 55 km of for bus rapid transit (BRT) corridors with four terminals. Other major infrastructure projects to be completed between 2007 and 2026 include junction improvements, road widening, flyovers, ring roads, and river crossings and bridges. With regard to non-motorised transport, the CMP strongly encourages providing pedestrians and cyclists with continuous and safe paths, but the CMP implementation program mentions only the provision of pedestrian subways or foot over-bridges. Thus, there is a gap between what the CMP wants to achieve and how it intends to achieve it. The CMP is lacking in key transportation planning areas. It does not address the need for an institutional arrangement—such as a special purpose vehicle (SPV)—to manage and operate urban transport modes are the dominant means of transport in the city transport. In addition, the CMP fails to address parking management. Regarding the public transport measures, the CMP recommends 420 new buses to increase the fleet size to 650. However, the CMP does not address the required financial and physical resources (such as additional service planning /operations / maintenance personnel, depots, etc.) to support such a significant increase to the bus fleet. Intermediate public transport (IPT) modes such as auto rickshaws are the most ubiquitous form of transport and are available at almost all places of the city, based on observations. The CMP calls for regulation of auto rickshaws in the form of dedicated parking spaces and the usage of fare meters, which will require enforcement from the traffic police and the regional transport office. Aside from the CMP, there are proposals for a Special Economic Zone (SEZ), townships (which will host a large number of housing complexes, commercial establishments), and industrial corridors linking Mumbai, Delhi and Pune. Other rapid transit options such as metro rail are also being considered and a Metro feasibility study is planned by NMC.

C. Methodology: MRTS Mode Selection

Public transport mode choice is driven by the potential passenger market for public transport, the trip patterns of prospective users, and other socio-economic criteria. We recommend implementing a high quality Bus Rapid Transit (BRT) system as a critical step toward improving the overall public transport system. In Nashik, we strongly favour BRT over other systems such as tram, monorail and metro based on the following advantages:

- Ability to meet existing passenger demand and scale up to meet future demand;
- Ability to provide flexible services, and change service design for increase in capacity;

- Adaptable Right-of-Way (ROW) designs to accommodate narrow streets;
- Low implementation cost,
- Rapid implementation timeline.

D. Introduction to Bus Rapid Transit (BRT):

BRT is a high capacity rapid transport system that provides safe, comfortable, efficient and economical services to millions of transit customers worldwide. BRT includes the following:

- High quality, frequent service that is proven to attract users from personal vehicles.
- High quality stations with platform that match the level of the bus so that passengers can enter and exit quickly and easily without climbing steps.
- Specially designed buses that operate in exclusive lanes in the centre of the street.
- Special bus fleet that is electronically monitored from a control centre to ensure reliability and provide real-time information to passengers.
- Smart ticketing at stations enhances passenger convenience and improves efficiency.

BRT systems offer the following advantages over other forms of rapid transit (monorail, metro, etc.):

- Not bound to a track, bus routes can be easily adjusted and consist of a combination of corridors.
- Buses can also exit the track and serve nearby areas, thus providing direct connectivity.
- BRT can be built in a short period of time (under 18 months) and at a fraction of the cost of rail systems (≈ □20 crores / km of BRT vs. ≈ □150 to □450 crores / km for rail-based systems).
- At grade, low-impact BRT stations are quick and easy for customers to access.
- BRT systems have the potential to provide a capacity over 20,000 (matching metro performance) using passing lanes and articulated vehicles.
- BRT operations plans can include multiple services per corridor and express services.

High capacity BRT systems are successfully operating in many large cities across the world including Bogotá (Colombia), Mexico City (Mexico), Seoul (Korea) and Guangzhou (China), often integrated with rail systems and providing complementary services. Many developed countries like USA and France are exploring BRT solutions to provide high-quality, cost-effective rapid transportation to manage the demand for private vehicle travel. The Mass Transport Feasibility Study finds that BRT is feasible and urgently required in Nashik. Simple improvement of bus service may not be a viable option, as measures to control the use of private vehicles are extremely limited. The appropriate solution for Nashik is a full-featured BRT system that pairs significant improvements in bus performance with other elements, such as a dedicated right-of-way for buses that is segregated from general traffic.

E. BRT for Nashik:

We observed shared auto rickshaw and MSRTC routes, and also completed traffic counts, frequency-occupancy counts, and parking surveys across the city to get a better understanding of the existing traffic conditions. Interviews with key agencies, including NMC, MSRTC, the Regional Transport Office, and the Traffic Police, were completed as was exhaustive analysis of agency data. The proposed Phase BRT network comprises 26 km of dedicated BRT corridors and serves a large portion of the Nashik Metropolitan Region. Corridors were selected based on the following basic criteria:

- Demand for travel based on existing MSRTC bus and shared auto rickshaw networks and volumes.
- Potential for future growth per Nashik's development plans.
- Opportunity to integrate with other existing modes of public transport.
- Existing public rights-of-way (ROW) for ease of implementation.

The Nashik BRT will be a closed system with a dedicated fleet. The following services will be provided:

- Trunk services: Operating entirely in dedicated BRT lanes.
- Direct services: Operating in dedicated BRT lanes and then extended up to 3 km beyond the trunk corridor to provide better connectivity and attract ridership.
- Feeder services: Operating in mixed traffic, bringing passengers to terminals and stations on BRT trunk corridors.

To extend the reach of the BRT corridors, two direct services are proposed as part of Phase I: an extension to Gangapur Village and an extension passing near CEAT colony. In summary, Phase I includes the following corridors:

1) Gangapur Road from CBS to Serene Meadows, including loop MG Road and Shalimar (7.5 km).
a) Extension to Gangapur Village (2.75 km)
2) Trimbak Road from CBS to Shramiknagar / Mahindra & Mahindra via Mico Circle and Satpur (9 km).
a) Extension to CEAT (3.25 km)
3) Nashik Road Railway Station to CBS via Dwarka Circle and Tilak Path (9.5 km).

Phase I also includes the following feeder routes serving Eklahare, Deolali Camp, and the Nashik Road Station area, and the city centre. Together, the trunk and feeder services are expected to handle around 2 lakh boardings per day. A detailed service plan should be carried out to determine the precise routes and schedules.The Mass Transport Feasibility Study identifies a 45.1 km Phase II BRT network that extends BRT service east across the Godavari River and provides service on the remaining corridors with considerable public transport demand. Finally, the study identifies additional future corridors so that corresponding road reservations and depot space may be earmarked as part of the upcoming revision of Nashik's Development Plan. The Nashik BRT will feature centrally located island stations that serve two-directional bus movement. The stations and buses both will have a floor height of 860 mm, allowing for stepless boarding. For Phase I, the BRT fleet will consist of 115 trunk buses (passenger capacity of 72), 40 feeder buses (capacity of 60), and 17 microbuses (capacity of 20). The 12 m trunk buses will have doors on both sides, including two right-side doors providing level boarding at stations and two left side doors for stepped access to kerbside stops on the BRT extensions. The feeder and microbuses will have a low floor

height (380 mm). The entire fleet will be air-conditioned. As corridor volumes increase, the Nashik BRT system will need to introduce 18 m articulated buses with a passenger capacity of 140. Stations, terminals, and depots should be designed to accommodate articulated buses without major structural modification.

II. RESULTS AND ANALYSIS

The traffic and frequency occupancy counts yielded a significant amount of data related to the way that Nashikars are currently mobile. It was observed that per each survey location, the majority of travellers were either using bus or two wheelers. Across all locations, approximately 10 per cent (in blue) utilised shared and private auto rickshaws. To assess potential demand for MRT service in Nashik, I completed a detailed analysis of Nashik traffic at strategic locations in the city. Frequency-occupancy surveys of MSRTC bus and shared auto rickshaw passengers were conducted to estimate passenger volumes on major corridors. In addition, existing bus routes and shared auto routes were mapped. Passengers on buses, auto rickshaws, and two wheelers constitute most of the potential users of an MRT system. Auto rickshaw and bus customers are the most likely to immediately utilise any new system. Based on the experiences of Ahmedabad and other BRT systems, we estimate that at least 20 per cent of motorised two-wheeler users are likely to switch to public transport in the short term if presented with an improved service. Thus, to implement a mass rapid transport system the existing network of services must be identified and analysed. First, I completed interviews with MSRTC staff who provided a comprehensive listing of all MSRTC local routes and stages (319 total) as well as a specific number of the local routes that were the most heavily utilised. The key routes and public transport passenger volumes were mapped to determine existing patterns of use and travel demand. Next, I reviewed the services offered by Nashik's shared auto service. While the MSRTC data illustrate key corridors and high demand services, the full transport network is only revealed when patterns and passenger volumes of IPT are considered. The 15 corridors shown and listed below in are identified as particularly suitable for mass rapid transport. The demand estimates are derived from existing bus and autorickshaw passengers plus 20 per cent of two-wheeler passengers, who are likely to shift to a high quality MRT service.

MRT Corridors:

- Nashik Road (from Khadkali Signal to Nashik Road Railways Station)
- Shalimar (Khadkali Signal) to Trimbak Naka (CBS)
- MG Road (Meher Chowk) to Shalimar (Khadkali Signal)
- Old Agra Road (From Ashok Stambh to CBS)
- Gangapur Road (from Serene Meadows to Ashok Stambh)
- Trimbak Road (from CBS to Shaneshwar Nagar)
- Vishwatmak-Jangali Maharaj Road (from Shramiknagar to Shaneshwar Nagar)
- MG Road to Nimani (via Malegaon Stand)
- Peth Road (from Nimani to Ozar)
- NH-3 (from Garware to Dwarka Circle)
- NH-3 (from Dwarka Circle to Panchwati)
- NH-3 / State Highway 17 (from Nimani to Adgaon)
- Ambad-Sathpur Link Road (from Garware to Ambad Police Chowki)
- Untwadi Road (from Mico Circle to Uttamnagar)
- Proposed Inner Ring Rd (from Jehan Circle to Ambedkar Nagar via ABB Circle & Indiranagar)

BRT for Nashik must address the mass transit need of the city along the major corridors carrying high volumes of peak passenger demand. Therefore we recommend that Nashik BRT be a closed system with a dedicated bus fleet. In a closed system, access to use the dedicated BRT corridor is limited specially designed BRT vehicles. For example, high-quality BRT systems such as Bogotá's Transmilenio and Ahmedabad's Janmarg maintain high performance by ensuring that all BRT services are provided by designated BRT vehicles. The Nashik BRT system will consist of the following services:

- Trunk services: Operate entirely in dedicated BRT lanes.
- Direct services (BRT Extensions): Operate in dedicated BRT lanes and then extended up to 3 km beyond the trunk corridor to provide better connectivity and attract ridership.
- Feeder services: Operate in mixed traffic, bringing passengers to terminals and stations on
- BRT trunk corridors.

A. Project Costs

1) Potential Funding Costs

The Nashik BRT project is eligible for capital grant funding from MOUD under the Jawaharlal National Urban Renewal Mission's Urban Infrastructure and Governance grant programme. As a city with a population between 10 and 40 lakhs, Nashik is eligible to receive 50 per cent of the project cost from GOI. As per MOUD guidelines, the Government of Maharashtra will cover 20 per cent of the costs and NMC, 30 per cent.

Funder	Proportion (%)	Expenditure (Crore Rs.)
Government of India	50	248
Govt. of Maharashtra	20	99
N.M.C	30	149
Total		496

Table 3.2: Total average expenditure

2) Operation Costs

The operating costs for the proposed BRT system includes costs of bus operations, administration and operations management, and maintenance of IT systems and infrastructure. In order to estimate the cost of bus operations for the Phase I of corridors, it is assumed that each bus will operate at least 240 km per day. The duty of drivers, supervisors, and mechanics will be scheduled in 2 shifts per day. The cost of bus operations is estimated to be Rs 56.3 crore per year. Additional operating expenses include cleaning, security, and maintenance of IT systems. To estimate such costs, information from the Ahmedabad BRT was extrapolated to generate estimates for Nashik. Staff salaries and maintenance of hardware and software for the IT systems is expected to cost around Rs 2.4 crore per year.

Security, maintenance, and administrative expenses will amount to around Rs 2.0 crore per year. Overall operating expenses total Rs 60.7 crore per annum, or Rs 43.4 on a per-km basis.

3) Fare Structure and Revenue Estimates

The primary source of operating revenue will be passenger ticket sales. The existing fare structure for MSRTC bus services in Nashik is distance-based. Fares range from Rs 7 up to Rs 54 for 50 km. For trips up to 30 km, the fare can be approximated as Rs 7 plus Rs 0.88 per km. The fare for children is half that of adults. Since the bus fleet for the Nashik BRT will be procured with assistance from JNNURM and the state government, the bus operator only requires compensation for the direct expenses of running the buses plus a reasonable return on investment. The full cost of operations, including bus operations, IT system operations, maintenance, security, and administration is approximately Rs 31 on a per-km basis. Assuming an average trip length of 4 km (derived from MSRTC's average ticket value of Rs 10), revenue per passenger-km of Rs 2.6 (at the current average trip length), 50 per cent of customers availing a 50 per cent discount through passes or concessions, and an average all-day occupancy of 30 per cent, bus services stands to earn Rs 43 per km from farebox revenues. Thus, farebox revenues are slightly lower than operating expenses. In order to close the operating gap, additional revenue streams can be obtained from station and bus advertisement rights or from personal motor vehicle user charges, such as parking fees.

III. Conclusions

The ultimate sustainability of any BRT system depends as much on the system "software"—the business and regulatory structure—as on the "hardware"—the buses, stations, busways, and other infrastructure. Typically, much emphasis is placed on the physical aspects of BRT, such as corridor design, bus stations, and vehicles. These are very important elements that determine the quality of any BRT system. However, the success of BRT is also a function of effective cooperation among multiple government authorities and contracting structures that facilitate efficient involvement of the private sector.

Organisations that will be involved in the implementation of BRT in Nashik include the following:

- Nashik Municipal Corporation
- Nashik Traffic Police
- Maharasthra Regional Transport Office

It will also be necessary to coordinate closely with the existing public transport service provider, MSRTC. In addition, NMC will need to enter agreements regarding infrastructure construction with the line agencies that own each stretch of corridor (such as the Maharasthra State Department of Highways and the National Highways Authority of India). Considering the present structure of administration and operations of city bus services in Nashik, it is advisable to establish a separate entity under the immediate guidance of NMC to look after public transport in Nashik. This entity would be a dedicated cell and a team of people whose primary job is to oversee the operation of bus-based public transport in Nashik. This entity, known as a special purpose vehicle (SPV), should take the form of a limited company under NMC. The SPV will plan and implement the BRT project. Once operations begin, the SPV will oversee operations, ensure a high standard of service quality. Specific services such as bus fleet operations and maintenance, IT services, and electronic fare collection, would be procured by the SPV from the private sector to ensure that service of the highest quality can be maintained at the lowest cost to the government. The SPV needs qualified, professional staff and the independence to make swift decisions during the implementation process. An IAS officer should serve as the CEO of the SPV. She/he will be supported by a competent team with specializations in the areas shown below. A board chaired by the CEO and including the Mayor, Standing Committee Chairman, opposition party leader, the Deputy Commissioner of Police for Traffic, the Regional Transport Officer, and a representative of the Urban Development Department, will oversee the SPV.

References

[1] Amina Tabti-talamali, Tahar Baouni (2018)," Public transportation in algiers: towardsanew governance approach", Case studies on transport policy **,**Volume 6, Issue 4, December 2018, Pages 706-715

[2] Bhaskar Naik, Praveen Kumar, Somanath Majhi (2019),"Smart public transportation network expansion and its interaction with the grid", International Journal of Electrical Power & Energy Systems, Volume 105, February 2019, Pages 365-380

[3] Madhu Errampalli, K.S. Patil, C.S.R.K. Prasad(2018),"Evaluation of integration between public transportation modes by developing sustainability index for India cities ",Case studies on transport policy, https://sci-hub.tw/10.1016/j.cstp.2018.09.005

[4] M. Nassereddinea, H. Eskandarib(2017),"An integrated MCDM approach to evaluate public transportation systems in Tehran ",Transportation Research Part A: Policy and Practice Volume 106, December 2017, Pages 427-439

[5] O.A.Elrahman (2019) ," Governance of environmental health and transportation decisions: The case of New York City", Case studies on transport policy, Volume 7, Issue 2, June 2019, Pages 463-469

[6] Poku-Boansia, Greg Marsdenb (2018),"Bus rapid transit systems as a governance reform project Michael", Journal of Transport Geography, Volume 70, June 2018, Pages 193-202

[7] Pradip Kumar Sarkar , Udit Jain (2017),"Benchmarking of Personal Rapid Transit System (Dynamic Model)", Transportation Research Procedia, Volume 25, 2017, Pages 4207-4218

