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## Integrated Multi-Modal Transportation for India

Saurabh P. Choudhary<sup>1</sup>, J. C. Gogte<sup>2</sup> and Prasad Kulkarni<sup>3</sup>PG Student<sup>1</sup>, Professor<sup>2</sup> and Visiting Professor<sup>3</sup>Department of Architecture,  
MGM's Jawaharlal Nehru Engineering College, Aurangabad, (MS), India

Corresponding author email : ar.sourabh@gmail.com; Contact : +91-9908330390

### ABSTRACT

Transport infrastructure development is an integral aspect of development of cities. There is a growing demand of increased mobility and accessibility with the growth of urban economy. On one hand, a well-planned transport system ensures increased mobility and on the other hand, efficient land use provides for better accessibility to the residents of a city. Multi-modal integration of transport is a modern and rapidly evolving concept which improves the overall commuting efficiency by creating synergies between different transit modes.

These stations are interconnecting hubs, often called as Transit Hubs; which facilitate passengers to change transportation modes in their transit without leaving the station premises. With the increasing congestion on roads, it becomes important to merge various transit modes at a single hub, to help minimize the transit time, provide seamless and barrier free mobility for commuters and also reduce the traffic on roads. To solve this problem, many countries around the globe have started redeveloping their existing stations as intermodal stations. This paper aims to understand the public transport and problems related to it in India. Efforts are made to identify the benefits and the need for multi-modal transportation for Indian Cities.

**Keywords:** Public transport, Multi - Modal Integration, Transit Hubs

### 1. Introduction

Transportation is one of the integrated parts for the functioning of a Society. Transportation systems improves the socio-economic progress and further transforms the society into an organized one. It is one of the vital forces for determining the directions of development. It is essential to provide organized facilities in the system to achieve the desired transportation balance for the system to be efficient.

As transportation involves the movement of people and goods, there is need for an access point in the system for use. These access points are known as 'Terminals' or 'Fixed Facilities' due to their fixed location in the system.

The metropolitan cities are growing at a faster rate due to their functional characteristics and employment potential. In the present situation the demand and supply of public transport in the city

is growing in an alarming rate. Inter - modal transit hubs along with proper facilities need to be proposed to balance this gap between demand and supply of the transport system considering the present and future scenario mass transport system/ integrate.

The importance of the terminals/fixed facilities in the transport system becomes especially important as the existing facility is not capable of meeting the demands of the day. Significantly, the location of the transport hub is most important in integrating the transportation system within a metropolitan city [1]. The problems are more pronounced in central areas where the available transportation facilities are unable to meet the demand. The increased inter-city traffic is in direct conflict with the intra-city traffic thus creating problems of movement. It is against this background that the planning and development of mass transport system with a methodological approach becomes very important.

### 1.1 Public transport scenario in India:

Land, water and air are the main transportation systems in India. Public transport is the prime mode of transport for most Indians and this is why India's public transport system are among the most massively used in the world. The Indian automobile sector is at present growing at a rapid pace with an annual production of over 47 lakh vehicles at an annual increase of about 10.5% and vehicles volume is estimated to rise greatly in coming years. [2] Indian Railways network is the third longest and the most heavily used transport system in the world by transporting over 825 crore of passengers and over 97 crore tonnes of freight annually, as of 2015. About 1.80 crore citizens travel daily by Indian Railways. In 2015-16, 106 National Waterways (NW) were declared by the Government of India, under the Inland Waterways Authority of India. This was done to cut down the transportation costs and to reduce the carbon footprint by shifting the traffic from roadways and railways to waterways. [3]

Despite current developments in the transport sector, several aspects of the transport are still facing problems due to outdated infrastructure and lack of financing in less economically active parts of the country. The demand for transport infrastructure and services has been growing by about 10% annually with current infrastructure being unable to meet these growing demands. As per the WRI Cities hub report, the recommended city wise public transport share can be referred from Table 1.

**Table 1. City wise public transport share**

Name of City	Recommended Share (%)	Actual Share (%)	Gap Share (%)
Nagpur	65	10	55
Varanasi	55	09	46
Panipat	35	01	34
Ludhiana	55	01	54
Udaypur	35	06	29
Kanpur	65	18	47
Pune	65	29	36
Ahmedabad	65	27	38

It can be observed that there is an acute shortage in all classes of cities as against the growing demands. [4]

### 1.2 Urban transport problems in India

Indian roads are highly congested and are of poor built quality. The lanes capacity is low. Majority of national highways only have two lanes or less. Road maintenance is less funded resulting in deterioration of roads and increased transport time and costs for the users. [3]

The Urban centres are extremely crowded. In metro cities, roads are usually congested during peak

hours. The sudden growth in vehicle ownership during the past ten years has reduced the peak hours travel speed, especially in the central areas of major cities. Airport infrastructure is also strained. Air traffic is continuously been increasing, leading to huge burden on infrastructure at major airports, especially in Delhi and Mumbai airports which account for more than 40% of India's air traffic. Mumbai airport overtook London's Gatwick airport as world's busiest airport with only one operational runway at a time. Mumbai airport handled a record of 51 movements in one hour on 16th September 2014, which means one landing or one take off every minute.

At present, the terminals of different modes of transport are located at different locations, as per the availability of space; or not integrated with each other. For Example, Mahatma Gandhi Bus Station (MGBS), Hyderabad, Telangana state; is situated in Gowliguda (Imlibun) area, whereas its nearest Interstate Railway Station is at Kachiguda (South Central Railway Division), which is 4.60 KM away from MGBS.

This results in, people have to travel from one mode of transport to another mode with their luggage which further leads to physical and mental strain for commuters. The problems becomes worst for the elderly and people with disabilities.

Reasons behind people not preferring Public Transport are:

- Inconvenience in terms of location of stations,
- Lack of seamless travel,
- Fear of crime at stations or during moving from one place to another,
- Financial loss, Harassment or cheating from rude auto rickshaws / taxi drivers,
- Overloading of vehicles (auto rickshaws / taxis) makes rides uncomfortable,
- Lack of safety in terms of road crossings,
- Public dissatisfaction at cancelled routes,
- Increase in travel frequency and travel time,

- Increased traffic flow around stations, slow down traffic circulation,
- Increased noise and activity around stations disturbing neighbouring residents / businesses,
- Lack of passenger information, integration, design, priority, security, options, fares, coverage and frequency are also some of the reasons.

The problems in transportation results into accidents, jams, parking issues shown in Figs.1-3.



**Fig.1 Problems in transportation -road accidents**



**Fig.2 Problems in transportation -traffic jams**



**Fig.3 Problems in transportation -parking issues**

## 2. Multi-Modal Integration

Multi-modal integration refers to decision making that considers various modes like walking, cycling, personalized vehicles, intermediate public transport, Public transit system, etc. and connections among modes so each can fulfil its optimal role in the overall transport system. Other transport options should not be seen as competitors to public transport, but rather as complementary elements of each other. Any public transit system is incomplete without intermodal integration.

Multi-modal integration aims to maximize the use of public transportation thus making public transport more attractive. It ensures that destinations are reachable by public transport alone, by improving the user experience and by reducing the burden and costs of transfers from one mode to another.

Urban rail systems, especially suburban local trains and metro rely on large numbers of commuters outside of walking distance from stations. These commuters typically depend on feeder services like buses or auto rickshaws or taxis. Hence, it is important that these modes are effectively integrated to gain the best benefit. [4]

The Trans bay Transit Centre is a visionary transportation project that is transforming downtown San Francisco by creating a new transit-friendly Transit Centre surrounding the neighbourhood. The Trans bay Transit Centre is an intermodal transit station in downtown San Francisco. It will serve as the primary bus terminal and later rail terminal for the San Francisco Bay Area.

### 2.1 Benefits of Multimodal Integration [5]

The benefits of multimodal integration are narrated as follows:

#### 2.1.1 Prospective advantages to Transit Operators and Agencies

- Increased profit and productivity due to increase in number of travellers and fare revenue.
- Reduction in civic body's services and support.
- Availability of more marketable and attractive surroundings for travellers.
- Possible improvement of service on less frequency routes due to reallocation of resources.
- Reduction in route surveillance requirements when several feeder services end at transit hub.

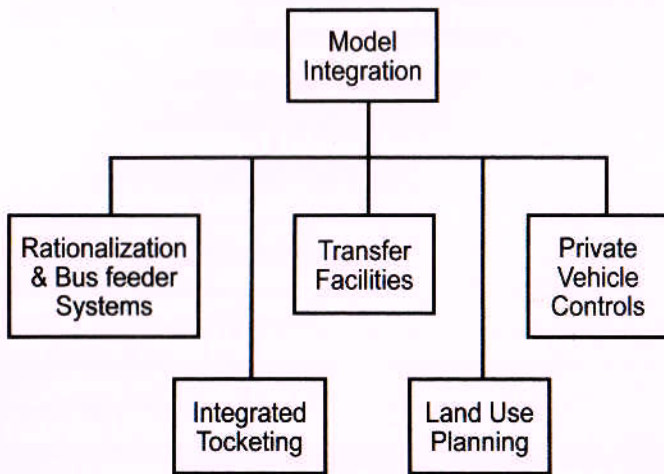
#### 2.1.2 Prospective advantages for Travellers

- Highly accessible and mobility friendly environment.
- Possible time savings on same route.
- Various options for selection of transport route and services at transit hub.
- Greater interchange comfort at transit hub.
- Possible improvement of services on less frequency routes.
- Decrease in pollution and environmental deterioration earlier caused by route duplication.
- Improvement in traffic movement.
- Economic advantages due to less congested corridors.

## 2.2 Achieving Multimodal Integration

Multimodal Integration is achieved through following aspects as given in Fig.4

1. Rationalization and Bus Feeder Systems
2. Integrated Ticketing
3. Transfer Facilities
4. Land-use Planning
5. Private Vehicle Management / Restraint



**Fig.4 Achieving Multi-modal Integration**

### 2.2.1 Rationalization and bus feeder systems

As rail system (metro, LRT, etc.) is developed, the objective of modal shift is change from private vehicles to rail transit. However, many cities observe different other ways of modal transfer from bus to rail transit. Hence, many cities have shown a drop in bus services as railway systems have gradually expanded. The examples are narrated as follows:

- a) Singapore has witnessed a similar shift but successfully recognized the importance of bus mode in transit system and hence have successfully maintained bus routes as feeder services to other modes of transport.
- b) In Bangkok, the lack of intermodal integration is observed along with charging of high fares on similar routes of sky train and buses. Sky train fares are about thrice the price of bus fares resulting in overcrowded buses while the overhead sky trains remain virtually empty.

### 2.2.2 Integrated Ticketing

#### A) Prospective advantages to Transit Operator and Agencies

- Reduction in fare evasion resulting in increased revenues.

- Potential increase in number of travellers.
- Highest flexibility to introduce and implement various schemes for fare charging.
- Improvement in seamless transfer of travellers in between different modes of transport.
- Improved effectiveness in data collection to estimate traveller's ridership along with their boarding and alighting patterns for reasonable revenue collection formula.
- Cut down on cash handling and administrative expenditure.
- Enhanced social image with modern advanced ticketing structure.

#### B) Prospective advantages for Travellers

- Major development in travel convenience (one single ticket compared to multiple travel tickets)
- Time saved because of single ticket or common ticket between different modes of transport or routes.
- Reduced concerns of travellers over automated fare deductions on multiple ticketing systems.
- Increase in popularity and attractiveness if frequent riders are provided with loyalty schemes for travel.

#### C) Prospective advantages for Public

- Improvement in passenger transfer will result in reduced through routes, resulting in improved traffic flow and circulation in congestion affected areas.
- Decrease in pollution and environmental deterioration along the routes.
- Greater economic advantages if more number of passengers utilize public transport.

### 2.2.3 Transfer facilities

a] To boost integrated trips, the transfer movement of passengers from one mode to another mode of transport must be

- Swift and fast
- User friendly and
- Comfortable

b] Walking and waiting time should be reduced.

- Walkways and stairwells should be covered and protected from weather conditions
- Signage should be clear and legible, without raising ambiguity.

### 2.2.3 Land-use Planning

- Transport hubs with development and / or redevelopment activities around does promote modal integration and choice of travel mode.
- Residents and businesses are attracted by well-organized land use patterns which facilitates goods access and feeder services. Thus, transit centres can be used as development cores and to increase the efficiency of the transport system.

Bangalore City has proposed Bayappanahalli Intermodal Hub in Bangalore to integrate Namma Metro, BMTC buses, KSRTC buses and Indian Railways. It will be well connected by bicycle lanes and pedestrian pathways. Offices and commercial activities are proposed, along with a multi-level parking lot.

### 2.2.4 Private Vehicle Management / Control

- Modal integration and efficient use of public transportation can be achieved when some form of control is enforced on the use of private vehicles.

- e.g. Park and Ride facilities (in the USA) and Congestion Pricing (in Singapore)

### 3. Assessment of Multimodal Integration:

The assessment of multimodal integration is carried as follows:

1. The main objectives of Road transport services is to ensure co-ordination between different modes of transport such as rail, metro, waterways, airways, etc. to eliminate competition or parallel operations as far as possible.
2. It is also the policy of the Corporations to locate its bus terminal in close proximity of Railway/ Metro Stations for the convenience of passengers. With the co-operation of the Railway/ Metro Authorities, land for Bus stations and for parking of co-operations vehicles adjacent to the Railway/Metro Station to be secured wherever possible.
3. Specific terminals have specific locational constraints, such as port and airport sites. New transport terminals tend to be located outside central areas to avoid high land costs and congestion.
4. Transit hub location plays a major role in multi-modal community. When the commuters finds the distance between origin and the destination are too far to be walkable or enjoyable, then commuting by car or motorcycle to the station may be preferred as a practical solution for the last mile connectivity from origin to destination, or use of shuttle / feeder services like taxi, auto rickshaws, etc.
5. The public transport systems offer innumerable advantages to the community:
  - a) In terms of number of persons per unit area of the vehicle, the public transport are better than any private transport; hence congestion on road will be reduced to a greater extent.

- b) In terms of the amount of energy consumed per passenger per kilometre, Public transport system is superior to private mode of transport.
  - c) An efficient public transport system will serve more people and especially the economically low income group.
6. Multi-modal commuting include lower fuel, lower maintenance costs and increased automobile life. These costs benefits are balanced by the costs of transit.
  7. Multi-modal commuters rely on certain degree of co-ordination and an alternative mode of transport; if in case, a train is running late or even cancelled, then the commuters can easily opt for another mode of transport available at the same location; to reach their destinations.
  8. While travelling from one place to another and using one mode of transport to another, commuters can switch over under a common place without even facing extreme weather conditions, thus making it possible for a seamless transfer.
  9. In Indian context, it is very important to integrate all different modes of transport like bus, rail, metro, shuttle / feeder, etc. with mass rapid transit systems. It is equally important to integrate non-motorized modes like pedestrians, bicycles, etc. to mass rapid transit system.
  10. For integrated multi-modal transit system, the interchange, seam less travel and barrier free mobility are significant components of an integrated transport strategy as these are part of the infrastructure.

#### 4. Conclusion

In India, the number of personalized vehicles have increased in many folds during the last decade; which further results in deteriorating traffic and environmental conditions. Due to this

there is a persistent need to shift mode of travel from personalized vehicles to walk / cycle for shorter distances and to public transport for longer journeys. An integrated multi-modal transportation is a step ahead to achieve this goal. Commuting by multi-modal transport gives combined benefits of walking, cycling or driving with the benefits of mass rapid transit, while balancing some of the disadvantages of each individual mode of transport.

In future, integrated multi modal transportation will be an area of research and development for scientific and practical implementation of Urban Planning. Most Indian cities are gearing up for improvement in transport infrastructure by executing various transportation projects. Integrated multi-modal transportation is the next advanced level of upcoming developments for appropriate integration of various modes of transportation. The biggest challenge for Indian cities would be to achieve the highest level of integration of multiple modes to shift the captive ridership of personalized transport to at least partial usage of public transport for mixed-mode travel.

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