Study of Bus Rapid Transit system In Respect to Growing Cities of India

[1] Ajay Mishra, [2] Saxena Anil Kumar, [3] Purohit Pradeep.
[1]P.G. Student, [2]Professor & P.G Program Head, [3]Associate Professor
1, 2,3Samrat Ashok Technological Institute, Department of Civil, Vidisha.

Abstract: Bus Rapid Transit System (BRTS) is the Safe, Economical, Rapid, Convenient & New concept of Public transport in Indian scenario perhaps in India there are more than 150 series of B.R.T.S was running successfully world wide the few examples are Bogota, Beijing, etc, Ahmedabad (India) is also a successful example of BRTS. Population wise India is the second largest country & fastest growing economy of the world. Presently the population of India is 130 Millions & Approximately 42 Millions people's lives in the growing cities but in the past decades there are no considerable development in the field of urban transportation so due to this reason & also tremendous growth of vehicular population on urban roads causes the congestion & traffic jam condition in the most of Indian cities. Now this is the time to think about the urban transport. BRTS is the most economical eco-friendly solution of public transportation for growing cities of India. Public transport is operated by the unorganized sector in all most cities of the India, which is the main cause of poor quality of public transport facility in Indian cities i.e. over loading, un-standard fare, unqualified drivers & staff, unscheduled movement causes the inconvenient & unsafe journey for user of public transport. But a BRT network with comprehensive coverage can serve a diverse market (all income ranges) by moving large numbers of people between locations quickly and reliably throughout the day, while maintaining a comfortable riding experience. These characteristics are essential to satisfying the demands of a diverse market or offering high-frequency service without heavy subsidy.

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

1. Introduction

Bus rapid transit (BRT) is a bus-based mass transit system. A true BRT system generally has specialized design, services and infrastructure to improve system quality and remove the typical causes of bus delay. Sometimes described as a "surface subway", According to the **National Bus Rapid Transit Institute**, BRT is, "an innovative, high capacity, lower cost public transit solution that can significantly improve urban mobility. This permanent, integrated system uses buses or specialized vehicles on roadways or dedicated lanes to quickly and efficiently transport passengers to their destinations, while offering the flexibility to meet transit demand. BRT systems can easily be customized to community needs and incorporate state-of-the-art, low-cost technologies that result in more passengers and less congestion." BRT aims to combine the capacity and speed of a light rail or metro system with the flexibility, cost and simplicity of a bus system. To be considered BRT, buses should operate for a significant part of their journey within a fully dedicated right of way (bus way), in order to avoid traffic congestion. The first BRT system was the Rede Integrada de Transporte in Curitiba, Brazil (translated as 'Integrated Transportation Network') which entered service in 1974. But at that time this system was not quite popular. In Year 2000 the TransMilenio system in Bogotá, Colombia was opened and get a grand successes, after the successes of TransMilenio system bagota the concept of BRT is adopted world wide. Moreover 100 BRT Systems was running successes fully around the world & approximately 150 series are under construction so there are no more questions related to the success & efficiency of BRT.

In addition, a true BRT system will have most of the following elements:

1. A bus way alignment in the center of the road (to avoid typical curb-side delays)
2. Stations with off-board fare collection (to reduce boarding and alighting delay related to paying the driver)

3. Station platforms level with the bus floor (to reduce boarding and alighting delay caused by steps)
4. Bus priority at intersections (to avoid intersection signal delay)
5. Dedicated lanes (to reduce travel time & for high operational speed)
6. High capacity vehicles (to increase the passenger carrying capacity)

2. Literature Review

Many researches were carried out by many scholars and professors of civil engineering in this field to Optimization of Public Transport Demand.

Sharma Anupama (2010), has studied that the BRTS being a flexible system can run on the street across the street, over the street or on canal banks. Although it serves communities best when built on surface, BRTS can be run on elevated structures or in tunnels if necessary. Stations and right of way are compact and efficient. With respect to total BRTS travel times, BRTS projects with more exclusive running ways generally experience the greatest travel time savings compared to the local bus route. Exclusive transit way projects abroad operate at an average speed of 35 kms per hour and Arterial BRT projects in mixed flow traffic or designated lanes at 20- 25 kms per hour).

Centre for Environmental Planning & Technology University, Ahmedabad (2006), Based on project particulars and existing environmental conditions, potential Impacts have been identified that are likely to result from the proposed BRTS project. The positive environmental impacts are

- Reduction in Traffic congestion,
- Reduction in road accidents
- Quick and improved service and safety,
- Less fuel consumption,
- Reduction in Air Pollution,
- Faster city traffic movement for all modes.

Although there are no adverse effects on the macro-climatic conditions (precipitation, temperature and wind) within the road corridors, microclimate maybe temporarily modified by vegetation removal and the addition of increased pavement. The negative impacts are mainly restricted to the areas adjacent to the road. There may be an increase in daytime temperatures on the road surface and soil due to the loss of shade trees. However, replanting of trees will eventually result in the re-establishment of canopy in 10 to 15 years.

ENVIRONMENTAL IMPACT ASSESSMENT FOR DEVELOPMENT OF BUS RAPID TRANSIT SYSTEM IN NAYA RAIPUR BY SENES Consultants India Pvt. Ltd.(2011)
As per the concern Naya Raipur is the new & growing city of chhatisgarh, once all planned development is completed, the estimated traffic demand in peak hours along the major roads in Naya Raipur has been estimated at12000 PHPDT (passengers per hour per direction of traffic flow). Since Naya Raipur is planned to be a major economic generator through various industries, planning an effective environment and people friendly mass rapid transit system which is safe, sustainable and economic and efficient, from the very beginning becomes extremely critical and is one of the major intentions of NRDA. Accordingly, a BRT System has been proposed in Naya Raipur, which would connect Raipur and Naya Raipur and also serve the main corridors of Naya Raipur. The system capacity is planned to cater to the traffic demand in Phase I (2013) to start with and will be amplified in subsequent phases to meet the development of Naya Raipur.

Bus Rapid Transit Features and Deployment features for U.S Cities- Journal of Public Transportation, Vol 12, No 2, 2009,
BRT Systems usually use vehicles that are distinct from regular bus service. They often have high-capacity, low floors, ergonomic seats and multiple wide doors. These designs contribute to improved ride quality, comfort, and reduction in dwell time. The use of articulated buses appears common. Nonetheless, articulated buses are recommended only when high capacity is desired without the need for increasing the frequency of service along the line. The design of vehicle should be considered together with station and shelter designs. A key issue when selecting/ designing BRT vehicle is the interior design. In some case, the interior of a vehicle may be comfortable for riders. Beijing's BRT is a example of an inadequate design since the capacity of its 60- feet reduce boarding time. Asian and Latin American cities with a high passenger demand opt to use high floor vehicles for better ride quality. Area coverage by BRT systems is necessary to attract ridership. However, extensive area coverage may lead to frequent stops and longer travel time. Service frequency is one of the measures of transit service quality. A high frequency implies lower average wait times for customers. This feature usually attracts ridership and is a key component in the total travel time. In the U.S BRT service headways range from 3 to 20 minutes, while in Latin American countries the headways vary from less than 1 minute. In countries with high passenger demand, such as India the average headway during the day is continuously should be less then 3 minutes.
In terms of capacity, which is dependent on the combined effect of vehicle capacity, route coverage, and service frequency, BRT vehicles or fleets can also be competitive with rail-based mass transit systems. BRT systems in the U.S usually have lower passenger demand, which leads to lower design capacities compared to systems in Asian and Latin American cities.

Limitations: As a means of establishing a rapid transit system from scratch, bus rapid transit is an incremental, affordable and versatile option to achieving that goal. For small to medium-sized cities, as well as along moderately-used corridors in larger cities, BRT may be all that is ever needed. In larger cities, however, as build-out proceeds and ridership grows, the inherent constraints and costs of a transit system based on buses alone along heavily-

used corridors become apparent. In those situations, conversion to light rail becomes an increasingly attractive prospect.

3. Study of BRT in Indian Scenario

3.1 General

Bus rapid transit (BRT) is a broad term given to a variety of transportation systems that, through improvements to infrastructure, vehicles and scheduling, attempt to use buses to provide a service that is of a higher quality than an ordinary bus line. The BRT will play a leading role in transforming public transport within cities to a situation where it will become the preferred mode of travel for the majority of residents, and where it will make a major contribution towards the more efficient development of the city as a whole, Currently a high number of daily passenger trips first go to the central parts of cities, before arriving at the final destination. These commuters no longer will have to travel via the CBD to reach their final destination. The public transport priority measures to be implemented will reduce travel times, having an enormous economic impact. Immediately after completion of the construction work, journey times for road users will reduce, having a positive impact on vehicle operating costs and savings on time in vehicles. In india the several BRTS projects are under construction and some in operational condition like Ahmedabad, Indore, Bhopal etc. and these projects are under the JNNURM program of Govt. of India. And executed by local bodies like municipal corporations. list of running projects as below.

Table 1: Detail of BRTS Projects in India

Cities	Length (In Km)	Segregation	System	Bus Stop Location
Delhi	14.6	Partial	Open	Middle
Bhopal	21.71	Partial	Partially Open	Middle /Side
Ahmedabad	88.50	Yes	Closed	Middle
Surat	29.90	Yes	Closed	Middle
Rajkot	29.00	Yes	Closed	Middle
Indore	11.45	Yes	Partially Open	Middle
Vijaywada	15.5	Yes	Open	Middle
Jaipur	26.10	Yes	Partially Open	Middle
Vizag	42.80	Yes	Close	Middle
Pune	124.77	Partial	Open	Middle

3.2 Need of Project

The main goal of BRTS is to provide a safe, convenient & timely public transport in urban areas for a common man. And make the street of cities congestion free. The increasing need for urban mass transit mobility is now being addressed by various cities in India, following the best practices in the world. The Jawaharlal Nehru National Urban Renewal Mission (JNNURM) which aims to encourage reforms and fast track planned development in 63 cities does consider projects in the field of urban, public transport. Safe, versatile, flexible and economic, the Bus Rapid Transit System (BRTS) also known as the High Capacity Bus System (HCBS) is increasingly being adopted by cities in India.

Image 1: Congested urban area of Bhopal

3.3 How BRTS System Works

The main features of the Bus Rapid Transit System are:

- Dedicated bus lanes which operate separate from all other traffic modes. This allows buses to operate at a very high level of reliability since only professional drivers are allowed on the bus way.
- A side benefit is lower construction costs since bus ways can be engineered to tighter standards and still remain safe compared to a roadway open to non-professional drivers.
- Location of the bus ways in the median of the roadway rather than in the kerb lane
- Existence of an integrated "network" of routes and corridors
- Separate stations that are convenient, comfortable, secure, and weather protected
- Stations provide level access between the platform and the vehicle floor
- Special stations and terminals to facilitate physical integration between trunk routes, feeder services, and other public transport systems
- Pre-boarding fare collection and fare verification
- Fare and physical integration between routes, corridors, and feeder services
- Entry to the system is restricted to prescribed operators under a reformed business and administrative structure
- Low-emission vehicle technologies
- System management through a centralized control centre, utilising ITS applications such as automatic vehicle location
- Special physical provisions to ease access for people with disabilities, such as children, the elderly, and the disabled

- Clear route maps, signage, and / or real-time information displays that are visibly placed within stations and / or vehicles.
- A bus street or transit mall created in an urban centre by dedicating all lanes of a city street to the exclusive use of buses.
- Low-cost infrastructure elements that can increase the speed and reliability of bus service include bus turnouts, bus boarding islands, and curb realignments.
- Comprehensive coverage: In addition to using dedicated bus ways, BRT's can also take advantage of existing roadways in cities that already have a comprehensive road network for private automobiles.

Serves a diverse market with high-frequency all day service: A BRT network with comprehensive coverage can serve a diverse market (all income ranges) by moving people from their current location to their destination with high frequency and reliability while maintaining a high level of customer experience.

Image 2: Congested free BRTS Ride in Bhopal

3.4 Benefits of Bus Rapid Transit System

In last two years since the first BRTS Corridor of Ahmdabad's and now recently the corridor of Indore & Bhopal is began operation the rapid passenger transport system is contributing to the reduction of the city's severely congested roads and associated air pollution for which the cities are infamous.

The implementation of the BRT is seen as an economic development project with short, medium and long-term impacts and benefits. The main focus in India is on growing cities ambitious plans which will form the backbone of, if not the framework for, a new-look cities dominated by wide boulevards lined with landscaped pavements, multi-storey parking facility affordable flats, offices, shops and entertainment venues. The system and the accessibility it brings will go a long way towards physically and mentally integrating the city and improving the quality of life of inhabitants. Reliable public transport will also "result in more flexible employment and transport arrangements", which are currently often constrained by the existing bus and taxi systems.

Short Term Benefits of BRT

- Efficient, reliable and frequent public transport services
- Affordable fares
- A safe and secure public transport system
- Accessible public transport for people with disabilities and mothers with children
- A decrease in traffic congestion, energy consumption and vehicle emissions
- An enhanced urban environment
- Recapitalisation of the public transport fleet.

Image 2: Level Bourding at BRT Station in Bhopal

Medium Term Benefits of BRT

- Containing urban sprawl (spread of settlements) and promoting densification
- Promoting social inclusion instead of isolation
- Job creation

Long Term Benefits of BRT

- Better economic development at and around the nodes as well as along the mobility spines.
- Land use change along the route as well as the nodes, which will result in densification.
- Sustainable and frequent peak and off-peak public transportation system.
- Improved journey times for all public transport users
- Reduction in pollution

A world class public transport system which the City can be proud of.

Image 3: New Devlopment along The BRT in Pune.

3.5. ENVIRONMENTAL IMPACTS

Based on project particulars and existing environmental conditions at Ahmadabad, potential Impacts have been identified that are likely to result from the BRTS project.
The positive environmental impacts are listed below:
• Faster city traffic movement for all modes
• Reduction in Traffic congestion,
• Quick and improved service and safety,
• Reduction in road accidents
• Reduction in Air Pollution,
• Less fuel consumption,

3.6 Challenges to the Rapid Transit System

There are unfortunately risks to the timely implementation & Operation of the Bus Rapid Transit System:

- Lack of support by the public transport industry where some of the public transport operators don't want to support the project or don't want to change to the new operations.
- Developing a robust business and financial model by obtaining buy-in from existing operators and financers
- Taxi Associations have blamed government for going ahead and implementing the BRT without thoroughly explaining to them how it will work.
- Taxi owners say they cannot compete with BRT because the system will have dedicated lanes.
- One of the challenges faced in the construction of local BRT systems is the time factor
- Environmental impact assessment process and outcomes with concerns about increased noise levels and objections to expropriation of existing houses.
- Budgetary constraints may cause delays and implementation over a longer period.
- The biggest concern to get buy-in from a consumer point of view is personal safety. implement video monitoring, as well as an increased police presence, to allay public fears.
- Other concerns are around the negative perception of buses when compared to private vehicles (and rail services) in terms of journey comfort and trip time.
- Training owners and operators in skills needed for successful Bus Rapid Transit operations.
- Educating users and potential users.

4.0. Comparison with light rail/ metro systems

After the first BRT system opened in Curitiba in 1974, cities were slow to adopt BRT because they believed that the capacity of BRT was limited to about 12,000 people per direction per peak hour (PPHPD). While this is a capacity rarely needed in the US (12,000 is more typical as a total daily ridership in the US), in the developing world this capacity constraint was a significant argument in favor of heavy rail metro investments in some venues.

When Bogotá's TransMilenio system opened in 2000, it changed the paradigm by giving buses a passing lane at each station stop and introducing express services within the BRT infrastructure. These innovations increased the maximum achieved capacity of a BRT system to 35,000 passengers per hour. Light rail, by comparison, has reported passenger capacities between 3,500pph (mainly street running) to 19,000pph. "From these findings ... there is little evidence to support the view that LRT can carry more than bus-ways." There are conditions that favor LRT over BRT, but they are fairly narrow. To meet these conditions you would need a corridor with only one available lane in each direction, more than 16,000 passengers per direction per hour but less than 20,000, and a long block length, because the train cannot block intersections. These conditions are rare, but in that specific instance, light rail would have a significant operational advantage.

5. CONCLUSION

This paper has reviewed and summarized the infrastructure and operational features of BRT systems India. Most of the BRT systems reviewed share common but not all BRT features. When designing a BRT system, the features should be selected according to project budget, local users, and traffic and corridor characteristics and combined to produce maximum ridership attraction and operating speed. Taking into consideration the limited BRT success and ridership and high right-of-way cost in Indian cities, the BRT features have been grouped into three deployment phases. The features recommended in the different phases are in increasing order of cost, engineering sophistication, and implementation time frames, but they also correspond to more positive effects on ridership attraction and operating speed. The

phases may be implemented in sequential order for a BRT system to be sustainable.

REFRENCES:

1. AN OVERVIEW ON BUS RAPID TRANSIT SYSTEM by Agarwal P K, Sharma Anupama, Singh A.P "JERS/Vol.I/ Issue II/Oct.-Dec.,2010/195-205"
2. Bhopal City Link Limited. Bhopal Municipal Corporation.
3. Bus Rapid Transit Features and Deployment Phases for U.S. Cities Published on Journal of Public Transportation, Vol. 12, No. 2, 2009
4. Bus Rapid Transit System, Bhopal, Presentation by BCEOM International France, Bhopal Municipal Corporation, Sept., 2008, (downloaded from Internet, Nov., 2009)
5. Case study:-Social Cost and Benefit Analysis for BRT, Road Research in India 2008-2009, IRC Highway Research Board.
6. Environmental Impact Assessment. DRAFT WORKING PAPER -9 ENVIRONMENTAL IMPACT ASSESSMENT by Centre for Environmental Planning & Technology University, Ahmedabad.
7. Kadiyali,L.R,(2008),Traffic Engineering and Transportation Planning, Khanna Publishers, Seventh Edition, Delhi.
8. Singh, A.P., (2010), Strategies for Development of Environment Friendly, Safe and Efficient Public Transport System, M.Tech Thesis submitted to Dept. of Civil Engineering, Maulana Azad National Institute of Technology, Bhopal.
9. Tiwari Geetam, Bus Priority Lanes for Delhi, Transportation Research and Injury Prevention Program, Indian Institute of Technology, Delhi, India 110016
10. Workshop, Bus Rapid Transit System, Department of Transport, Government of the National Capital Territory of Delhi, 12-13,Dec., 2005, Delhi. (downloaded from Internet, Nov., 2009)