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Bus Rapid Transit System (BRTS) - A Sustainable Approach- Literature Review

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Abstract

Cities in the developing countries in general and India in particular, are in search of sustainable solutions to their accessibility and mobility issues. The process is complicated due to the rapid pace of urbanization, which is characterized by motorization, the co-existence of motorized and non-motorized modes, deteriorating public transport services and institutions and deteriorating air quality. A variety of modes such as walking, cycling, two-wheelers, Para-transit, public transport, cars etc. are used to meet the travel needs in urban areas. Public transit systems world over are struggling to complete with private modes and the shift is noticeable in the developing countries as well; the predominant modes being cars, two wheelers and other intermediary modes. At present, public transport becomes financially less viable, speeds reduce, and congestion levels increase and the transportation becomes a source of environmental problem. So, to compete with these requirements BRTS is one of the most solutions of these problems. The aim of the present paper is to introduce BRTS which is the sustainable solution for public transport services in urban area of Indian city. This paper highlights how we can improve the public transport through BRTS on the basis of literature.
Keyword- BRTS, Metropolitan Transport Scenario, BRTS Infrastructures, Public Transport

I. INTRODUCTION

Presently, the whole world is finding the sustainable solutions to their accessibility and mobility issues. The process is complicated due to the rapid pace of urbanization, which is characterized by motorization, the co-existence of motorized and non-motorized modes, deteriorating public transport services and institutions and deteriorating air quality. Urbanization is a significant phenomenon at national level, after post-independence era. It was 17.29% in 1951 and touched 27.75% in just five decades. The urban population in India has been 285 million out of 1027 million in 2001. It has built up more pressure particularly in metropolitan cities.

Travel demands have grown faster than the population and the expansion of the city, resulting in movement between the city center and suburbs. Travel demand is also determined by a number of factors, the primary one being the size of the population. Other determinants include per capita trips and the average trip length. Urban travel demand tends to grow faster than the population due to increase in per capita trips (1.3 in 1982 had risen to 1.6 in 2008) caused by a growing economy and the longer trip lengths necessitated by expanding city size.

Urban transportation plays a key role in urban development. It facilitates the smooth movement of goods and people within cities. As per the 2011 census, the urban population in India in 2011 was 360 million (m), constituting 30 per cent of the total population. It grew from 159 m (23 percent) in 1981. It is projected to grow to 820m (46%) by 2051. The burgeoning urban population in rapidly expanding cities has resulted in growing urban travel demand. Urban transport is a nightmare in India. Indian cities, of all sizes, face a crisis of urban transport. It enables functioning of urban areas efficiently by providing access and mobility. With growth, the mobility needs increases. Despite investments in road infrastructure, and plans for land use and transport development, all cities face the ever increasing problems of congestion, traffic accidents, air, and noise pollution.

Bus Rapid Transit as name implies "Rapid Transit", which describes a high-capacity transport system with its own right-of-way, implemented using buses through infrastructural and scheduling improvements, to provide a high level of service. BRT System is regarded as sustainable, environmental friendly transport mode and is being implemented in many cities of the world (IT, 2007). BRTS is a bus based transit system which allows higher speed, improved capacity and better bus safety by segregating buses from other roadway traffic into a separated bus way (Levinson et al. 2003). BRTS (Bus Rapid Transit System) is defined as a “flexible, high performance rapid transit mode that combines a variety of physical, operating and system elements into a permanently integrated system with a quality image and unique identity” (FTA).

Present paper elaborated the present conditions of Indian metropolitan cities for a public transport in mixed traffic conditions. The aim is to reduce the congestion, pollution and time of peoples who travels through public transport. BRTS is introduced as a sustainable for all the problems created due to the mixed traffic. The benefits, policy issues and necessary infrastructures are also introduced in this paper.

II. METROPOLITAN TRANSPORT SCENARIO

India is the second most populous country in the world and home to about 35 cities with populations of more than 1 million. India has had favorable rapid economic growth for more than a decade now. Increased income has paved the way for rapidly increasing levels of motor vehicle ownership and use, particularly in city areas. The emerging traffic situation has resulted in alarming levels of congestion, air pollution, noise, and traffic danger. Or most segments of the population, mobility and accessibility have declined with time. Although the four mega-cities (Delhi, Mumbai, Kolkata and Chennai) have rail-based mass transit routes, the limited coverage of systems in these cities and generally unorganized, poor-quality, inadequate bus services (similar to other Indian cities) have resulted in an improper public transport supply in Indian cities. Also, apart from Delhi, no significant efforts have been made recently to improve bus travel, which accounts for over 90 percent of all public transport use in India. With sharply increasing income and car ownership levels in Indian cities, it is important to preserve the competitive position of public transit in order to be able to retain and/or increase the patronage through improved quality of service.

In India most of metro cities are finding their public transport system inadequate due to the fast improvement in socio-economic condition in metro cities, which had resulted into increased demand for travel. It has been observed that with increase in the sprawl of the city, average trip lengths would naturally increase. The maximum trip length in metro cities is higher compare to medium and small cities. It has been observed that the average trip length is 2.4 km with population 5 lakh and it is 10.7 km for cities with population greater than 80 lakh. Significant decrease in public transport and a very high increase in private mode share for all city categories are predicted and due to this phenomenon more street congestion develops in the metro city.

A variety of modes such as walking, cycling, two-wheelers, Para-transit, public transport, cars etc. are used to meet the travel needs in urban areas. Public transit systems world over are struggling to complete with private modes and the shift is noticeable in the developing countries as well; the predominant modes being cars, two wheelers and other intermediary modes. People's personal choices and freedom get expressed in increased ownership and use of personalized vehicles. The public agencies operating public transport systems often fail to restructure service types to meet with the changing demand pattern. As a result public transport becomes financially less viable, speeds reduce, and congestion levels increase and the transportation becomes a source of environmental problem. The agencies operating public transport often fail to respond to demands. The resultant outcomes in most Indian cities have been of increasing congestion due to increasing private modes, accidents and rising air pollution levels. Difficulties in foretelling the traffic levels, mode choice, affordability and willingness to pay for better services have compounded the problem. Figure 2 indicates the modal share of public transport and intermediate public transport.

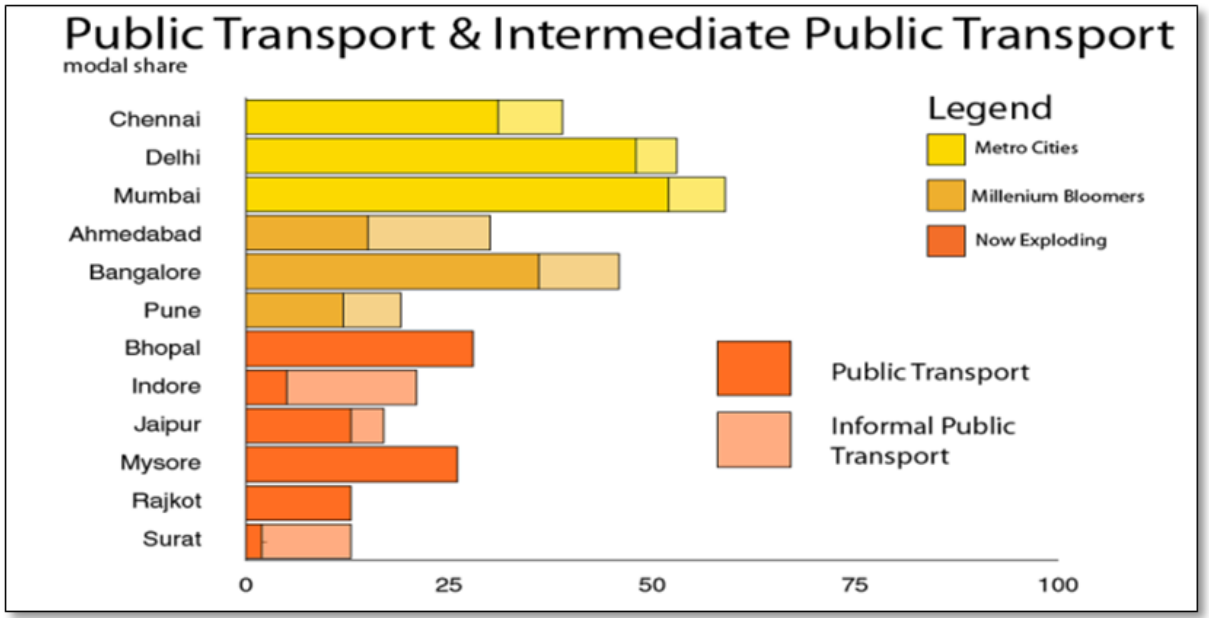

Fig. 1: Modal share of public transport and intermediate public transport.

In 2007, it has been observed that about 39% of total trips in Indian cities are carried by walk and bicycles, whereas public transport carries nearly 27% of trips. Public transport share is considerably low, around 10% in metro cities, whereas it is 20-40% for mega cities which indicate the need of public transport in metropolitan cities. Kolkata is having highest share of trips by public transport modes; nearly 80%; followed by Mumbai with nearly 60%. Maximum share of trips by walk is observed in Kanpur with @ 70% followed by Ahmadabad and Bangalore with more than 40% walk trips. In Pune usage of public transport and private motorized vehicle is 41% and 22% respectively. Cities like Kanpur and Lucknow having usage of less than 5%.In general, the larger the city size, the higher the percentage of urban trips served by public transport in India: 30 percent in cities with population between 1 and 2 million, 42 percent for cities with populations between 2 and 5 million, and 63 percent for cities with populations

over 5 million. Thus, the especially rapid growth of large cities suggests a further rise in future demands for public transport in India.

A. BRT Approach

A variety of transport modes, both private (walking, cycling, two-wheelers, and cars) and public (para transit, buses, Bus Rapid Transit System (BRTS), light rail, monorail, suburban rail and metro) are used to meet these travel needs.While several mass transport options are available, BRT systems are chosen with the specific intent to balance the cost aspect with the appropriate method of delivering quality public transport services in the city. Amongst the domain of high capacity public transport systems available world-over, it has been concluded that the transport demand forecast on the major travel corridors in city can be managed by a medium capacity public transport system such as a Light Rail Transit System (LRTS) or BRTS with dedicated bus lanes. Market estimates peg LRTS costs at about Rs 200 crore per km as compared to BRT systems costing about 20 crore per km. LRTS or MRTS projects being capital intensive are considered financially unviable. BRTS has been recommended considering the following key drivers:

BRT promotes high-quality transit services on a cost-effective basis and will allow the management of city to develop a high-quality mass transport with affordable infrastructure cost and ability to operate without subsidies. The internal rate of return for BRTS in city is fairly high and sustainable / achievable by public funds even after considering expenses to be incurred for procurement and operation of rolling stock.

BRTS can be implemented within shorter periods (1-3 years after conception) – a significant advantage over rail based mass transport in addition to the cost effectiveness.

To successfully meet the transportation needs and travel demand of key local community transportation improvement stakeholders which include policy makers, transportation operators/agencies, corridor businesses transit riders composed of workers, commuters, shoppers, school children/students, seniors, and the disabled there is a major need to further analyze and measure BRT/Rapid Bus impacts prior to and after BRT/Rapid Bus corridor improvements have been implemented. Bus Rapid Transit System (BRTS) is a new form of public transportation which is an emerging approach to using buses as an improved high-speed transit system.

III. POLICY ISSUES-BRTS

A. Median versus Side Lanes

Exclusive bus lanes are mostly at grade, segregated from the existing volume of traffic by means of a physical separation. These exclusive bus lanes can be strategically placed either at the centre of the road (Median Bus lanes) or at the side (Side Bus lanes). Experiences worldwide suggest having BRT system in the central verge (median lane) of the roadway is better option than curb lanes.

B. Open versus Closed System

Open System: BRT system lane is kept open for all existing bus operators. The benefit of dedicated infrastructure is distributed to all operators.

Closed System: BRT system lane is restricted only for BRT buses. BRT operators remain the only beneficiaries and hence responsible for efficiency and maintenance. It is recommended to have a “Closed System” on the corridors where exclusive BRT system lane is proposed to be developed. The exclusive BRT lanes must be physically separated from the rest of the traffic by a physical barrier.

Exclusive/Dedicated versus Mixed Corridor: BRTS corridors having dedicated BRT system lanes shall have only BRT system bus service running. No other service shall be allowed to compete with BRT system. However, BRTS buses will share other feeder routes with other public transport where there is no provision of dedicated bus lanes. Such a facility is referred as mixed corridor. BRT system buses, other buses and other traffic will share the available right of way.

IV. MAJOR ELEMENTS OF BUS RAPID TRANSIT SYSTEM

The major elements of bus rapid transit are described below.

A. Running Ways

Running ways drive travel speeds, reliability and identity. Options range from general traffic lanes to fully grade separated BRT transit ways.

B. Stations

Stations, as the entry point to the system, are the single most important customer interface, affecting accessibility, reliability, comfort, safety and security, as well as dwell times, and system image. BRT station options vary from simple stops with basic shelter to complex intermodal terminals with many amenities.

C. Vehicle

BRTS system can utilized a wide range of vehicles, from standard buses to specialized vehicles. Options vary in term of size, propulsion system, design, internal configuration, and horizontal/longitudinal control, all of which impact system performance, capacity and service quality.

D. Off-Bus Fare Collection

Conventional on board fare collection slows the boarding process, particularly when a variety of fares are collected for different destinations and/or classes of passengers. An alternative would be the collection of fares upon entering an enclosed bus station or shelter area prior to bus arrivals (similar to fare collection at a kiosk prior to entering a subway system).

E. Service and Operation Plan

Designing a service plan that meets the needs of the population and employment centers in the area and matches the demand for service is a key step in defining a BRT system. How it is designed can impact system capacity, service reliability, and travels times, including wait and transfer times.

V. MERITS OF BRTS

Bus Rapid Transit (BRT) is commonly understood as a system that emphasizes priority for and rapid movement of buses by securing segregated bus ways, although there is no precise definition of what constitutes a BRT system. However, effectiveness of BRT is not always permanent. Vuchic pointed out that BRTs cannot succeed if police enforcement is not strict, citing the examples of Philadelphia and Mexico. Experiences from the U.S. cities such as Shirley Bus way in Washington and El Monte Bus way in Los Angeles show that pressures by automobile interests are threat to the existence of BRT. Relationship of BRT to other modes is a crucial factor for the success of BRT: BRT cannot bring success as a stand-alone policy and effectiveness depends on the presence of complementary transport options, such as promotion of non-motorized transport and integrated feeder services. Another important factor for success understanding of planning and design elements, based on experiences in real-world conditions. Successful Bus Rapid Transit systems can be expected to produce improvements in bus service, operations, and ridership, and to affect traffic congestion and air quality. Some of the important advantages of BRTS are as under:

A. Bus Speeds and Schedule Adherence

Perhaps the most fundamental effect of a Bus Rapid Transit system, travel times would likely improve due to the lack of impediments to bus movement along exclusive bus lanes. Bus speeds would be expected to improve not only in absolute terms, but also relative to the automobile traffic that parallels the exclusive lanes.

B. Ridership

Ridership would be expected to increase due to improved bus speeds and schedule adherence. Customers who use buses infrequently might ride more often, and some automobile users might convert to transit. A visible improvement in bus speeds might be noticeable to drivers of other vehicles, presenting a positive image of transit as an alternative to driving.

C. Other Traffic

If the creation of exclusive bus lanes reduces the number of lanes available for other traffic, then in the short term the possibility of increased congestion on the roadways is raised. Traffic flow on cross streets and turning traffic may be disrupted as buses use their signal priority to travel uninterrupted through intersections. Further, mobility on alternate routes may deteriorate, as drivers seek ways to avoid roads with exclusive bus lanes. One of the challenges of implementing an exclusive bus lane would be to minimize this disruption.

D. Air Quality

Long term, as ridership increases and the overall level of general-purpose traffic decreases, urban areas may experience improved air quality due to reduced emissions from automobiles.

E. Saving in Travel Time

On the exclusive travel ways the person minutes saved is more than the person minutes lost by people in automobiles, which means significant saving in travel time. Exclusive travel ways reduce travel times in general about 1.5 to 2 minutes per mile (Hobert et al, 2004). Actual time savings are greatest when the previous speeds were the slowest.

F. Reduced Congestion

Congestion has long been recognized as an environmental problem. Other than causing delay, it causes noise and fumes and increases health risks to road users and residents. Cost estimates for HCBS are significantly less than the cost of grade separators, provided to reduce congestion.

G. Increased Safety

By creating segregated bicycle lanes and redesigning intersections, conflicts between motorized traffic and bicyclists can be reduced leading to a sharp decrease in the number of accidents and fatalities for bicyclists and motorized two-wheelers.

H. Bus Priority at Intersections /Signals

Preferential treatment of buses at intersections reduces delay to buses to a great extent. Intersection priority can be particularly helpful when implemented in conjunction with bus lanes or streets, because general-purpose traffic does not intervene between buses and traffic signals

VI. BRT STRATEGIC MARKETING MESSAGE

1) BRT is fast and reliable – it offers passengers a quicker trip with more dependability.
2) BRT is cutting edge – it maximizes transit performance by using state-of-art technology.
3) BRT is cost-effective – it moves people as effectively as light rail at lower capital cost.
4) BRT is a quick solution – with community support and sufficient funding, fast build out.
5) BRT is flexible – it maximizes operating flexibility by allowing multiple operators.
6) BRT is incremental – can be deployed in phases based upon funding availability and demand.

A. BRTS Infrastructure

Bus Rapid Transit (BRT) is growing in popularity throughout the world. The reasons are its passenger and developer attractiveness, its high performance and quality, and its ability to be built quickly, incrementally, and economically. BRT also provides sufficient transport capacity to meet demands even in the largest metropolitan regions. Main fixed facilities in BRTS are roads and bus stops. Other facilities include traffic signals, central operation control room, workshop, parking spaces, etc.

1) Infrastructure of BRT as Under

BRTS on the edge: In this section, BRTS is provided on the edge of the pavement. The separate lane is provided on the edge of the road as left side or right side.

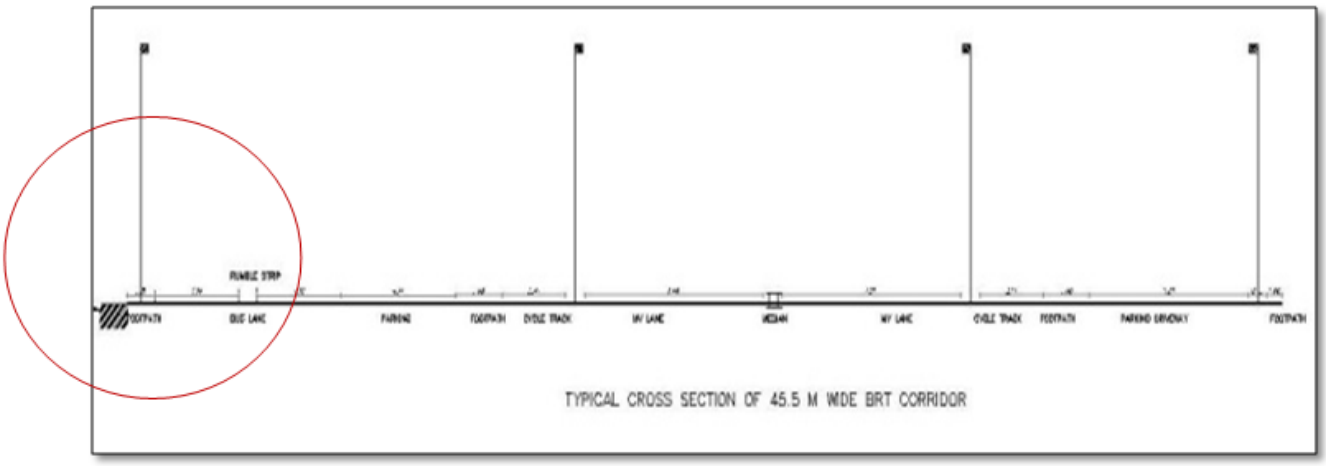

Fig. 2: BRTS on the Edge

BRTS Underground: BRTS is provided in the underground sometimes means using tunneling.

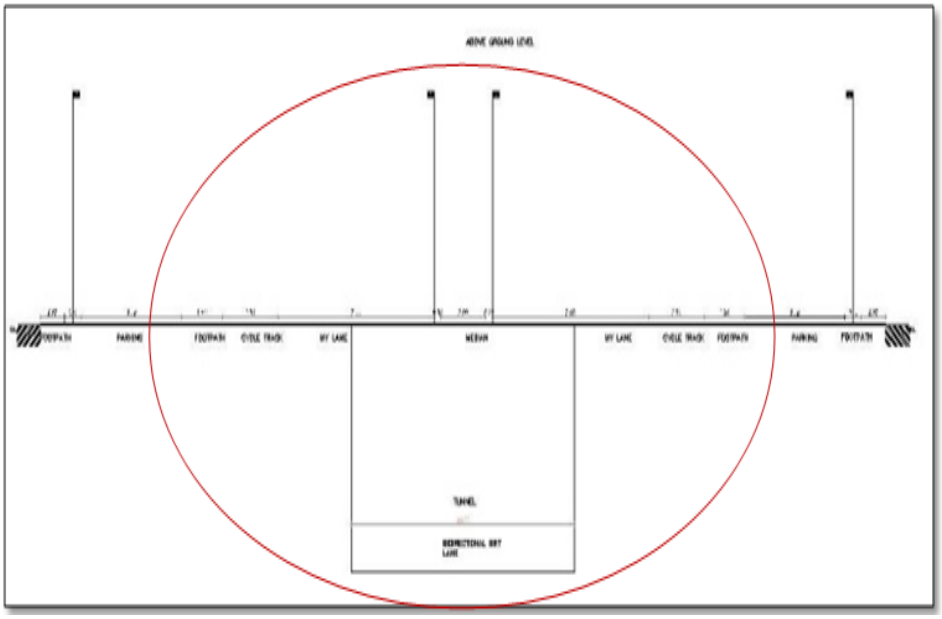

Fig. 3: BRTS Underground

BRTS in the center of the arterial: Most important infrastructure and which mostly applicable in India are this method. It is very easiest and fully separated right of way type BRTS corridor.

Fig. 4: BRTS in the center of the arterial road

B. Bus Station or Stops

1) Simple Stops

These stops are located at mid-block, or at intersections at spacing of about 500 m catering to boarding and alighting passengers along the corridor. The passengers will purchase the tickets and enter the system.

2) Interchange Stations

These stops are the contact points for the feeder buses and buses running along the main corridor. The objective of developing these stations is for smooth, fast and effective transfer of the passengers.

3) Main Line Stations/Terminals

These stations are located at the beginning and end points of the trunk routes. These terminals act as transfer points for the main trunk buses, feeder buses and the existing fleet of public transport buses. These terminals would be provided with parking and other necessary infrastructure facilities. The main terminals would also be serving as depots for parking and maintenance (workshops).

VII. CONCLUSION

As the population continues to grow, the demand for motorized vehicles will increase as well as congestion trip will increase on the metropolitan road. The increasing number of vehicles on the road will emit thousands of tons of pollutants into the atmosphere each year, affecting not only the city, but the entire globe. India has implemented numerous policies regarding vehicular emissions, but these have had little, if any, effect on the quality of the air. This requires planning a system, which is affordable, reliable and efficient from the user as well as operator's perspectives. A Bus Rapid Transit System (BRTS) offers an opportunity for creating a system capable of meeting multiple needs of users and operators which combines facilities, equipment, service and intelligent transportation system elements into a permanently integrated system with a quality image and unique identity.

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