

# Performance Evaluation of BRTS in various Indian Cities

Dharmkumar Shihora<sup>1</sup>

<sup>1</sup>Post Graduate Student, Town and Country Planning, Sarvajani College of Engineering and Technology (Surat, Gujarat)

## ABSTRACT

*India is developing country and has developed rapidly during recent years. Development can be related to increased urbanization. Many of Indian cities are lacking intercity transportation requirements in terms of physical expansion, growing population. Mass Transportation is an important factor for development of nation. To check the performance of any system, performance analysis is a tool. Performance Evaluation can be defined as "To determine how effectively policies, program, project is executed with regard to its goal and objectives". User satisfaction is an important parameter of performance evaluation, satisfaction can be defined as expectations and perceived performance prior to satisfaction. Thus, there is a great need to provide clean, efficient, affordable, effective and safe public transportation system and to achieve this Bus Rapid Transit System could be one of the solution. This paper presents an review of BRT systems implemented in various cities of India.*

**Keywords**— BRT, BRTS benefits, BRTS Problems, Performance evaluation, Public Transport

## 1. Introduction

In India traffic is heterogenous in nature where in variety of vehicles travel over a single road with variable speeds. Lack of mass transportation facilities tend to increase more usage of private vehicles and intermediate para-transit vehicles. All these combine makes the roads of city very congested and leads to increase in travel time, also increasing pollution very rapidly. Urban population in India has increased significantly from 62 million in 1951 to 285 million in 2001 and is estimated to be around 540 million by the year 2021. Another interesting phenomenon is constantly increasing number of metropolitan cities and their population. The number of metropolitan cities that is those with million plus population was only 5 in 1951 and by 1971, their number has jumped to 9; by 1981, the number of million plus cities increased to 12; by 1991, their number increased to 23; as increase of almost 100 percent from 1981 to 1991; and 2001 census, number of million plus cities has increased to 35. This number is expected to increase to 51 by the year 2021. The number of people living in Indian metropolitan as much as 107.88 million or 37.80 percent of the total urban population and this numbers are likely to grow in the coming years [1].

Public Mass Transportation System is a key component for development and growth of country. This system faces problem in almost all the developing countries [2]. Due to lack of financial and other important resources, it restricts the investments and funding for construction, maintenance and upgradation of existing as well as new transport systems. Inefficient public transport systems in India tends to various problems like accidents, traffic congestion, pollution, heat island effect, environmental degradation and overcrowding. Public Transport systems need to be safe, reliable, efficient, affordable and effective. BUS RAPID TRANSIT SYSTEM (BRTS) may be one of such solution to overcome the problem.

There is no perfect definition of Bus Rapid Transit (BRT).Wright (2005) defines it as a "bus-based mass transit system that delivers fast, comfortable, and cost-effective urban mobility [1]". Levinson et al. (2003)

defined BRT as “Implementation of flexible, high performance rapid transit mode that makes a physical, operating and system elements into permanently integrated system with a quality image and unique [2]”. The ‘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 [1].

#### **Characteristics of BRTS:**

- Segregated right of way
- Constructed on at grade level, easy to built up
- Inexpensive as compared to metro rail
- Automatic tracking of buses available
- Crossing is only available at zebra crossings, resulting in low fatality rates

## **2. Literature Review**

### **2.1. BRTS**

“Rapid transit is not a transport mode as such, but, it is means of mass transportation offering a faster service than the alternatives which are available, typically with average operating speeds of 50 kmph or more; this generally requires exclusive rights of way” [2].

“Bus Rapid Transit System (BRTS) is an innovative, high capacity, lower cost public transport solution that can significantly improve urban mobility [3]”

“Bus Rapid Transit gives communities the best bang for their buck when it comes to investing in transit. This new system will better connect workers to jobs, shoppers to stores and Oregon to the rapidly growing economy [4]”

### **2.2. BRTS Benefits**

H.S. Kumara [1] overviews Bus Rapid Transit Systems in Indian metropolitan cities and says that BRT system is an effective public transportation alternative to automobiles which has capacity to meet increased mobility needs and also support to improve the quality of life of Urban Metropolitan cities. High quality bus operations can create new improved land use options which can provide compact, environment friendly, pedestrian friendly development patterns which tends to preserve neighbourhood concept and green spaces. According to a recent analysis published in the Journal of Public Transportation, BRT system is the nest way to reduce transportation related CO<sub>2</sub> emissions and it can be implanted rapidly as compared to rail systems as a result it helps to attract passengers out of their car. Electric transit vehicles are powered by coals and other fossil fuels which has greater CO<sub>2</sub> emissions over long term as compared to BRT. New ITS technology can be implemented in BRT for smart card-based fare collection, automatic vehicle tracking system, passenger information systems, etc.

Agarwal P.K et al [3], 2010 overviews bus rapid transit system and describes BRT as high capacity, low cost public transport system which can improve urban mobility rapidly. As compared to rail transit, BRT is less costly to build and can provide quality performance with sufficient transport capacity. BRT system can utilize variety of vehicles from standard buses to specialized buses. ITS technology can be implemented in BRT to increase the performance in terms of reduce travel time, convenience, operational efficiency, safety and security of passengers. BRT travel on exclusive ways which saves travel time of passenger else time is lost by passenger in automobile and exclusive ways also result in increased capacity.

### 2.3. Problems related to BRTS

According to Agarwal P.K et al. [3], problems related to public transportation systems are as follows:

- 1) Design issues: BRT System occupies space on equitable basis for almost all type of vehicles, but introduction of this system tends to increase traffic problems like congestion, lining up of vehicles at junctions in motor lane. During peak hours, sometimes there are major delays and congestions especially at junctions.
- 2) Traffic Signals: Traffic flow is not constant during whole day, as a result traffic signals are unable to discharge flow and creates long queue of cars and other vehicles in motorized lane as well as bus lane. For now, only static traffic signal is installed in BRT corridor and many times it is shifted to manual control. Manual control can operate only single phase at a time which is not sufficient.
- 3) Environmental conditions: When BRT System was introduced, people residing around BRT corridor were promised that this system will reduce air pollution, but due to use of high polluting diesel buses pollution is increased and are not environment friendly. Trees were cut down to introduce the BRT corridor, but later no trees were again planted in median and around BRT corridor.
- 4) Land acquisition: At many places existing carriageway was too narrow to construct new BRT corridor. Due to consequent widening and construction of stations and depots, additional land acquisition was unavoidable and as a result some structures need to be cleared.

### 2.4. Performance Evaluation of BRTS

Kumavat C. et al [5], 2016 studied Delhi & Pune BRT Systems and identified some common problems in both the operating systems. Some recommendations were suggested to improve the Pune BRT System so that it can have a better result and avoiding shutdown as in case of Delhi BRT System. In Delhi, total 6 corridors were proposed with a total length of 310 km to be completed by year 2020. To avoid shutdown of Pune BRT System some recommendations were suggested like integration of existing system with new system to cut down use of private vehicles, to decrease cost of tickets to attract lower- and middle-income group people, pedestrian access improvement, etc. Some of the improvements needed for Pune BRT System were to conduct surprise visit and inspections to establish good control and discipline in people who manage the BRT System and passengers who use them. Traffic signals at every junction create traffic jams and resulting in increase travel time. Cleanliness of buses to be deployed should be checked every morning. Frequency and timings, especially of long routes should be increased and should be kept open till 12 AM in night. In fact, links connecting to train stations and airports should be accessible 24 hours.

Jaiswal A. et al [6] , 2012 studied impact of BRT System on Ahmedabad's transport sector. Ahmedabad BRT System has improved access for local riders and reducing environmental impacts of transportation. Various characteristics of BRT has been discussed like dedicated lanes, frequency, etc. As compared to rail transit, BRT is flexible in terms of route adjustment and re-routing over time. Both the phases of BRT are so designed that they do not overlap each other in which Ahmedabad Municipal Transit System (AMTS) is provided and it also has proper feeder system to feed the passengers. Traffic flow study is carried out to understand level of efficiency and also to correlate with proposed capacity. User survey analysis shows that, passengers who use the BRT System are very much satisfied and private vehicles are shifting towards public transport mode. After implementation of BRT System there is slight decrease in composition of pollutants around the corridors.

Shah S.D. et al (2015) [7] analysed performance of Surat BRT corridor from Udhna Darwaja to Sachin GIDC after conducting various surveys like questionnaire survey, on board BRTS survey and para – transit survey. 2 wheelers and auto-rickshaw were mostly used for trip and over 60% of trips belonged to job or work purpose while study or social based trips were to be second on the route. According to survey, labours preferred use of shared auto-rickshaw and 2 wheelers were mostly used for job or work purpose to travel for short distances. 60 % of passengers were not willing to use BRTS during morning and evening peak hours and were shifted to either auto-rickshaw or private vehicles. Around 65 % passengers rated accessibility and connectivity of BRTS as poor and around 25 % rated as average. Over the selected corridor BRT bus completed the cycle earlier as that of auto-rickshaw. Maximum passengers board at Udhna Darwaja and exit at Sachin – GIDC stop, at intermediate stops very few passengers stop to other terminal. Selected BRT corridor is not being used by people as it lacks accessibility for passengers who want to board from intermediate stops. Passenger who want to travel from Udhna to Sachin were the only ones to travel in BRTS.

Bhanu K.C. et al (2014) [8] studied on BRTS and corridor selection & assessment for the Hyderabad. Number of surveys were carried out to select the corridor for easy implementation of BRT System. After conducting survey corridor from Prashanth Nagar to Secunderabad was selected as it has high traffic volume, it also connects educational centre, industrial hub, business centre and most crowded area which is one of the important railway station in country. There were 5 junctions in the corridor: Balanagar, Bowenpally, Tarbund, Paradise and Patny. Various surveys like reconnaissance survey, passenger car unit survey, annual daily traffic survey and level of service survey were carried out on the corridor. Corridor was divided into 4 sections: Prashanth Nagar to Balanagar (1<sup>st</sup> section - 2.3 km), Balanagar to Bowenpally (2<sup>nd</sup> section – 4.02 km), Bowenpally to Paradise (3<sup>rd</sup> section – 3.72 km) and Paradise to Secunderabad (4<sup>th</sup> section – 2.2 km). Reconnaissance survey describes about total length of corridor as 12.24 km. Passenger Car Unit survey shows that maximum 2 wheelers were traveling in the selected corridor. Traffic volume count survey shows that maximum traffic was from Paradise to Bowenpally i.e. about 28266 vehicles per day. Level of service survey shows that all the four sections falls under category 'E'. After conducting various surveys, it can be concluded that current mode of transportation can not handle traffic if traffic volume increases. Therefore, to improve current transportation system BRTS can be the best choice to implement as it is cheaper as compared to other systems.

### **3. Conclusion**

Bus Rapid Transit System (BRTS) is an innovative, high capacity, low cost public transport solution which can improve urban mobility rapidly. In India currently, there are many operational BRT Systems and many more under construction & some are being planned. Performance evaluation of BRT System in existing cities is very much necessary to know how well it is providing the transport service and the area being served by the system. By evaluating performance of operational BRT System of Indian cities some improvement, operating decisions and recommendations can be made before implementing in other Indian cities. BRTS in India can be helpful to improve environment in Indian cities by shifting from private vehicles to more efficient, more reliable, more safe public transport system i.e. BRTS.

**REFERENCES**

- [1]. Kumara S., Planning for Bus Rapid Transit System in Indian Metropolitan Cities: Challenges and options, *Institute of Town Planners, India Journal 6 - 4, 09 - 21, October - December 2009*
- [2]. Panchore V., Khushwaha N., Performance evaluation of BRTS, *International Journal of Science Technology & Engineering, Volume 2, Issue 11, May 2016*
- [3]. Agarwal P.K, Sharma Anupama, Singh A. P, An overview on Bus Rapid Transit System, *Journal of Engineering Research and studies*
- [4]. Norman Y. Mineta, "Public transport passengers' perception and demand satisfaction: A case study at Petalingjaya municipal district, Malaysia." *Proceedings of the Eastern Asia Society for Transportation Studies, Volume .9.*
- [5]. Kumavat C., Sonawane H, Patel T, Sakhalkar X, Effective Learning from Delhi BRTS – A Case Study of Pune BRTS, *International Journal of Research in Engineering and Technology, Volume 5, Issue 4, April 2016*
- [6]. Jaiswal. A, Sharma A and Krishnan Y "Potential of Bus Rapid Transit System For Million Plus Indian Cities: A Case Study of Janmarg BRTS, Ahmadabad, India", *International Journal of Advanced Engineering Research and Studies, Volume 1, Issue 3, June 2012*
- [7]. Shah S, Patel R, Jain S., "Appraisal Study of BRTS Surat – A Sustainable Urban Transport", *Journal of Mechanical and Civil Engineering, Volume 12, Issue 4, August 2015, PP 29 – 37*
- [8]. Bhanu K., Maddali S., Introduction to corridor selection and assessment for Bus Rapid Transit System (BRTS) in Hyderabad, *American Journal of Engineering Research, Volume 3, Issue 6, 2014, PP 242 - 246*