

Evaluation of Urban Public Transport Demand: A Case Study of Bhopal

Prakash Chandra¹, Rakesh Sakale², Hirendra Pratap Singh³

^{1,2,3} Dept of Civil Engineering

^{1,2,3} School of Research and Technology, P U Bhopal (M.P.) India

Abstract- *Development in the motor culture has put huge impact including all metropolises motorways in India's million-plus regions, owing to increasing owning a vehicle and minimal transportation, particularly in cities with populations of 1 to 2 million people. The key reason why is because public transport system has a surprisingly low ridership due to poor quality of service and longer travelling time. The aim of this exercise is to investigate the rapid and non-rapid road transportation systems in Bhopal Revenues, expenses, gains, and loses are taken into account when determining economic strength and service quality, which is determined by commuters' perceptions of the calibers of the bus service. This can aid in the development of creative solutions to problems like increased commuter traffic, increased power consumption, and productivity improvements. It can also support the development of alternative public transportation options, making them more accessible to the general public, enabling them to meet equity goals, and increasing their financial efficiency. A new approach is also measured by estimating the actual transportation demand because the most feasible and appropriate framework could be appointed.*

Keywords- Public transport, Optimization Demand, Bhopal, transit demand factors

I. INTRODUCTION

The word 'Transport' is derived from the Latin word "Transport are", Here "Trans" means "across or the other side" & "port are" means "to carry". Therefore, transport means to carry the other side. From the above definition, we derive that "transport is a process of carrying goods and persons from one place to another". Transport acts like an instrument in the spread of development & mixing of culture. It is interesting to quote here the observation made by the author regarding the general significance of transport in the modern world. The transport is one of the great fundamental institutions of mankind. It develops with man's quest for advancement; it retrogrades with the breakdown of a social order. People without transport would be people without interaction with outside world & hence without the attributes

of civilization. The transporter is in true sense the builder of the civilization.

"One of men's most significant activities at every level of modern civilization has been the transportation industry, which focuses only on moving people and stuff from one location to another." With every new advancement in the domains of ways and means, the significance of transportation grows, motive power, engineering techniques, organizations, legal enactments and social, economic and political factors.

In these days, the development of transport is associated with the socio-economic and commercial importance. Transport proves to be an instrument for the development of a culture. Hence a society without an advanced transportation system remains primitive.

It is interesting to quote here the observation made by a famous author regarding the general significance of transport in the modern world. "The transport is one of the greatest fundamental institutions of mankind. Its history dates back to the dawn of recorded history and beyond. It develops with man's quest for advancement; it retrogrades with the breakdown of a social order. Anyone without access to transportation would not interact with the outside world and would therefore lack civilization's characteristics."

Bhopal is the capital city of the Indian state of Madhya Pradesh and the administrative headquarters of both Bhopal district and Bhopal division. It is referred to it as the City of Lakes because of its numerous man-made and natural lakes, as well as the fact that it is one of India's greenest towns. It ranks 131" globally and as the 16th biggest city in India. Bhopal was created as a state with the foundation of Madhya Pradesh.

The city, established in 1707, was as the seat of the Nawabs of Bhopal's princely British state, the old Bhopal State. One of the deadliest industrial disasters in history, the Bhopal tragedy, devastated the city in 1984. Under Prime Minister Narendra Modi's flagship Smart Cities Mission, Bhopal was chosen as one of the first 20 Indian cities (the first phase) to be built as a smart city. For three years in a row—

2017, 2018 and 2019—Bhopal was named as India's cleanest state capital.

II. LITERATURE REVIEWS

This chapter reviews the existing literature in the field of public transportation. It reviews various research papers, articles and books related to performance of public transportation especially the rapid transit system in leading cities of India and abroad.

1. National and local investment decisions should be predicted on objective and transparent evaluation of alternatives
2. National Transit investment schemes can help catalyze widespread of BRT as urban transportation
3. Project evaluation should consider the distributive impact.

Agarwal PK, et al. (2010) provided an overview of bus rapid transit system. They laid emphasis on the need, major elements, advantages, and impacts of BRTS in the Indian cities. They have studied both the positive and negative aspects of the system and on the basis of their small research, they have concluded that BRTS is a flexible mode; stations should be as close to intersection as possible & transit stations should be located in the heart of their target service area. They also concluded that facilities should be planned as per the commuters' requirement, signal system should be resorted to minimize the merging, and safety measures are to be designed suitably. [1]

Arora Sameep and Prashanth (2012), analyzed Demand Responsive Scheduling as a method for optimization of public transport operations. This paper details out a method of analyzing the data available with the agencies to optimize the schedules for individual routes. This paper presents a methodology for using operational data available with the public transport agencies to improve the service delivery and thus capture a greater share of urban transportation demand. The paper discusses the analysis by way of a case study of applying it to improve the scheduling on route 207 in the city of Bhubaneswar & compares the result of the same. Their analysis, while allowing for regular monitoring of the operations, can also lead to better planning and thus attract improved share of urban travel demand. The case also highlights the importance of using technology for public transportation operations and the need for proper reporting tools to translate the data into useful information. [2] Bhattacharya Shrimoyee et al. (2016) presented a paper with an objective to find the key sustainable development principles in urban development. They defined sustainable development on the basis of three aspects- economic

development, social equity and environmental protection. Researchers collected the data through the primary source i.e. with questionnaire. For sustainability, they articulated four major principles and they proposed a framework for the assessment of indicators based on the four thematic principles. Under the framework, assessment of indicator-sets was carried out. In such indicators, they took nine sectors. On the basis of this study, they concluded that Indicators equity and foresight indicators were not adequately expressed. A well design set of sustainable indicators is a vital a part which helps cities to evaluate the outcome of infrastructure projects and services. There is no need for mainstream sustainability indicators into municipal planning practices. [3] Carrigan Aileen et al. (2002) studied Social-Environmental- Economic Impact of BRT bus through four case studies. They studied cost, performance, impacts and contribution of BRTS. They used the available data in the case study to estimate the net benefit of BRTS to the society. The four cases they have included are: 1) Bogota's Trans Milenio 2) Mexico City's Metro bus 3) Johannesburg's Rea Vaya 4) Istanbul's Metrobus. [4]

Chaudhari Dron and Prof N.D. Haziani (2014) have analyzed the -Traffic Impact Analysis of BRTS. The objective of the study is to identify the impact of BRTS on traffic alone implemented corridor & on the adjacent areas of a four km run in the city of Ahmadabad. They analyzed the impact of BRTS on the speed of other vehicles and weather BRTS is a justified mode of transport or not. They took the public opinion survey method. On the basis of their research, they concluded that other traffic is largely affected due to BRTS, so one solution is to allow AMTS in BRTS lane. [5]

Dr. Harish M (2013) studied Urban Transport and Traffic Management- For sustainable Transport Development in Mysore. The objective of this paper is to identify traffic management viz. accessibility and mobility, safety and security, economic & environment. He had taken into consideration travel time, delays, congestion, and parking problems. He had collected secondary data from traffic police stations and regional transport offices, district statistics office, Mysore urban development authority etc. On the basis of his study, he concluded that in Mysore, the number of vehicles is increasing at a very fast speed but there is no change in the transportation management on par with the increasing vehicles. The city authorities are ignoring the transport planning and development such as encouraging car- pooling, implementation of BRTS, incremental technologies for traffic signal hardware, parking control standardization, better sign route maps & signals, automated toll collection for buses, bus lane implementation, efficient licensing system, synchronization of traffic signals etc. [6]

Dr. Verma Ashish et al. (2015) reviewed Urban Transport Policies in India in context to Climate Change: An International Perspective. The paper represents an overview of relevant policy instruments in the urban transport sector. Their paper is divided into two parts, first section describes the urban transport scenario in India and sector contribution to CGH emission and the later section explains the climatic change and how it needs to be addressed through urban transport. On the basis of their study, they concluded that there was a rampant urbanization, thereby increasing the number of vehicles which increase the GHG emission. Cities enacted urban transportation policy to reduce motorization. In countries like India, emission reduction, economic growth and social equity need to be considered, evaluated and implemented in time to achieve sustainable transport and wider socio-economic benefits. [7] Electricwala Fatima and Rakesh Kumar (2013) analyzed the framework of public bus transit in Indian cities. The main objective of the study was to understand the overall impact of introduction of a bus transit system through model shift and VISSIM simulation in million plus cities of India. This study is based on primary and secondary data and different characterizes of six corridors which were collected from the annual reports and journals of the company & questionnaire and discussion methods. The methodology of the study is Biogeme based multimodal logic model. From the study, it was found that the present commuters are willing to shift their different modes to the new bus transit system. VISSIM results show that there is no speed loss in car traffic even after the introduction of bus transit system. [8]

Elif Can Cengiz (2017) in the paper Bus Rapid Transit: An Environment Friendly Transport Solution for Istanbul discussed the positive impacts of BRT system on Istanbul's environment in terms of vehicles eliminated from general traffic and reduced the amount of carbon-di-oxide due to BRT. He collected secondary data from Metropolitan Municipality of Istanbul. On the basis of the research, he concluded that BRTS is successful in Istanbul which carries a large number of passengers. System provides high quality services and has positive effect on the environment too (by removing conventional bus & mini Bus). BRTS system not only provides the positive impact on the environment but also reduces the consumption of tonnes of fuel from public transport. [9]

Gaurkar Vaibhav (2013) studied the systematic organization of para-transit system (non- personalized public transport system) in context of Public transportation system. This paper is written with an objective to harmonies the relation between the public and para-transit system to optimize the use of urban transportation in Surat city. The data was

collected on the basis of observation and survey method. They observed the arterial routes of transportation in Surat city, they conducted survey from auto rickshaws regarding the average occupancy and house hold surveys regarding the routes. Scientific study was conducted regarding the trip assignments, operational routes of auto rickshaw, frequency of public buses etc. On the basis of their observation, they concluded that the total system needed to be optimized and well- coordinated in terms of fares, routes and frequencies. [10]

Getachew Legese et al. (2014) made a Comparative assessment of success and failure factors for implementation of bus rapid transit system in Accra & Bogota. The main objective is to study the critical success and failure factors for the bus rapid system projects implemented an Accra & Bogota and with distinct level of implementation in BRT. The study was conducted by the authors by using reviews of literature and experience of one of the authors in planning and implementation process. They used sustainable transportation framework to assess the planning and implementation of BRT in the two cities. The evaluation of BRT system was done on the basis of economic performance, social performance and ecological performance. [11]

Gupta Kanika et al. (2014) studied BRTS as an effective mode of transport. The objective of their paper is to consider identify the increasing need of urban mass transit mobility in various cities of India. They analyzed the case study of Ahmedabad BRTS. They collected the data from Ahmedabad BRTS source and concluded that BRTS is a good solution of meeting the increasing transportation demand of the city. It is equipped with better management, greater speed, and it is of course more economic and time saving too. Setting of BRTS is cheaper than setting MRTS because of its low operational and maintenance expenses. Increasing use of public transport would lead to decrease in the number of private vehicles, hence reducing the carbon emission.

It is sad that many advantages of nationalized bus services being provided by DTC are ignored. The socio economic advantages extended by the corporation's services far outweigh the case of privatization. DTC is too crucial a public utility to be left in the hands of the private operators for their narrow selfish commercial objectives. He advocates that the Government continues to be the owner of the organization. It needs to be sorted out as to what sort of relationship there should be between the Government and the management. Commercialization of DTC will imply that it must enjoy more powers in its pricing, investment and operational matters. Another related issue with regard to commercialization of DTC would entail fixing responsibility for the cost of social

obligations carried by it in the form of various concessional passes, provision of un-economic services, provision of special services like U-specials, office goers specials etc. Such social obligations would need to be quantified and the issue with regard to pricing/subsidy should be resolved. He also recommends that public transport should attract car users and other personalized and hired mode of transport, by giving amenities in the form of bus terminals, queue halters and suitable information system like display of route maps, time table etc." [12]

Jishnu Gohel (2014) analyzed a comprehensive review of BRT system introduced in Ahmadabad. The objective of this paper is to provide a literature review of the comparative analysis of BRTS with other transportation system justifying the needs and analysis for the same. For this, he carried out the detailed study of the prevailing BRT system in Ahmadabad. He also put his efforts to find out the comparative analysis between BRTS & metro and to understand the comparative benefits of BRT system for similar environment. On the basis of surveys, documents from the organization, recommendation of the channelized system of transportation, he carried out the detailed analysis of operational and financial feasibility of BRTS. He concluded that Ahmadabad being a compact city, characterized by mix land uses, high density development and balanced network system, here BRTS is a good option. [13] John Pucher et al. (2005) in their article public Transport in Seoul 'examined the introduction of new reforms in urban transportation. The reforms divided the entire bus system into four divisions and restructured a new bus system as BRT routes. Reforms integrated bus routes, schedules and fares with the metro system, introduction of the new system of BRT routes. In spite of tremendous disruptions, confusions, public discontent and political uproar in the initial stage of implementation, the reforms appeared to become a huge success. Within a year, 90% of residents expressed their satisfaction with the restructured new services and new fare system. BRTS appears to be better than metro over there. BRT in Seoul can provide excellent services at a very low cost. [14]

Khaturia Ankit et al. (2016) reviewed Bus Rapid Transit Implementation in India. This paper is a detailed review of BRTS implementation in various cities of India. They studied about the current system and network characteristics of BRTS, Ticketing system, cost revenue collection model & carriageway concept design of Indian BRTS. The paper gives a detailed review of BRTS implementation in eight cities of India on the basis of designed and operational characteristics. Data had been collected from the secondary source i.e, Global BRT data website. The statistical tools used for the study are coefficient of variation,

percentile for calculating operational efficiency. On the basis of their study, they concluded that ridership in India is dominated by the Ahmedabad BRTS. Indian BRTS is characterised by two types of system: open and closed system. Average achieved operating speed of BRTS is ranging between 18 to 24 km/hr. To improve the performance of the system off-board ticketing system is adopted. India adopted major reforms by formation of SPV companies in different cities in terms of regulatory concept. In gross cost revenue model, India adopted Kilometer based model as it is easy to understand. The most commonly adopted carriageway design is a row of 24 and 40 m. On the basis of operation, it was concluded that Ahmedabad and Delhi have the highest and the lowest average operating speed while Pune and Bhopal have highest and the lowest frequency. BRTS reliability measures are divided into three categories i.e. waiting time, headway regularity and TTR measure. Ring and radial pattern is majority planned for BRTS network of different cities because it gives a direct link to high and medium population density area around the city and radial network gives a privilege accessibility to the centre of the city. [15]

Kumari Priti and Pooja Podar (2016) made the comparison of BRTS and AMTS Ahmedabad with an objective to find problems and solutions of AMTS and BRTS in Ahmedabad city. Their main area of survey was spot speed, average speed, travel time, queue length, delays for current traffic before and after implementation of BRTS project. They have collected the data by primary survey through interview method. On the basis of their research, they concluded that BRTS is more reliable and helpful in the development of the city. [16]

Kushwaha Aditya et al. (2018) studied the traffic impact of BRTS in Indore city on mixed vehicle lane. The objective of this study is to find the impact of BRTS in mixed vehicle lane at some major intersection which suffered with congestion and high traffic flow before the implementation of BRTS. For this study, they have collected the data from traffic volume survey, spot speed survey, congestion index study, intersection saturation study. On the basis of this study, they concluded that traffic flow between the bottle neck sections is high and exceeds the capacity, there is a heavy congestion which reduces the speed of MV lanes, and industry house interaction seems to be heavily congested and saturated. [17]

Mahadevia Darshini et al. (2013) studied about the sustainable urban transport panacea with reference to Ahmedabad BRTS system. This paper shows that while catering to latent transport demand, Janmarg has not promoted inclusively or encouraged a shift away from private motorized transport. It has also given short shrift to non- motorized

transport system. Their paper is an attempt to fill the gap by undertaking an in-depth analysis of the BRTS in Ahmedabad. They studied the BRTS on the basis of two guiding principles sustainability mobility and equity. The data was collected from the secondary sources like ministry of Urban development and a survey through questionnaire in which samples of 1040 were drawn from 18 bus stations of Ahmedabad in week-days time on peak as well as non-peak hours. They included social, economic and transport-choice related questions in their questionnaire. On the basis of their study, they concluded that although BRTS is promoted as low cost public transport but it is not under the reach of urban poor people. They also state that if walking and cycling facilities were built along with BRTS corridors, it would have been another way of facilitating the mobility of urban people. The top down transportation planning has not really taken into account the need of urban people of Ahmedabad, It has not achieved a significant shift away from private motorized modes, low carbon mobility and social inclusion is still a challenge. Since BRTS is in implementation stage, there is still a chance of reforming its key components. [18]

Matariya Rahul D et al. (2017) made Performance Evaluation of Bus Rapid Transit System with an objective to access the performance of BRTS in smart cities. For research, they used various board surveys like travel time survey, delay time survey, passenger frequency survey, public opinion surveys which helped them in getting ideas like smart mobility, smart route connectivity, smart accessibility and smart traffic management for the future. On the basis of survey, they concluded that BRTS is associated with higher degree of innovativeness, high capability, low value transport resolution therefore the performance of BRTS in Indian cities helps in encouraging shift in personal mode of transport towards a lot more economical and safe public transport system. [19]

Nistor Filip and Catalin C. Popa (2014) studied about the role of transportation in economic development. Authors identified the role of transportation in developing a sustainable economy that will provide, in the near future, new services, ensuring better management and real time traffic capabilities in order to protect the environment and other safety. On the basis of their secondary data collection, they concluded that effect of transport & economic development can be direct or indirect. Investment in transport sector is a tool of development especially in developing countries.

On the basis of project planning and implementation recommendations, BRTS should be designed to accommodate the local travel demand and urban context, design of routes, services and infrastructure should aim to minimize passengers

waiting. Fare should be designed on the basis of technical methods and actual cost of operations and engagements with existing bus operators can build buy-in and ensure inclusion. [20]

Reddy B. Sudhakara and Balachandra P. (2010) studied the Dynamics of Urban Mobility. The objective of this paper is to analyses urban mobility patterns and consequent impacts on energy and environment in India. They investigated the energy use of 23 nations for the period of 25 years. This paper explores the relationship between three dependent variables- energy intensity, type of transport mode, and passengers' kilometers. They have collected the data from secondary source i.e. Indiastat.com, Ministry of Shipping, Road Transport & Highway, GOI, Indian OIL Corporation. On the basis of research, they concluded that car seems to be a dominating mode of transport. The use of energy increases day by day thereby accelerating environmental degradation. Lack of proper public transportation system is the single cause that hampers mobility and accessibility in Urban Region. Urban areas can reduce traffic congestion by charging cars that enters the city in peak hours. The risk of import of fossil fuel is mitigated by encouraging non monetized vehicles & secondly by increasing tax on personal vehicles. The integration of public transport, cycling, walking into a single lane make the city more livable than one that relies on almost exclusively on private automobiles. The best way is to develop such a vision with a strong and more representative local government through an open public disclosure. [20]

Rizvi Andrea (2014) studied How Planning process impacts bus rapid Transit outcomes: A Comparison of Experiences in Delhi and Ahmadabad, India with an objective to demonstrate the direct and indirect role of planning process influencing outcome of BRTS. This research collected the data in three phases 1) online availability of published material, newspaper article, literature, policy reports and other documents. 2) Semi structure interviews with key decision makers, officials, relevant agencies, stakeholder 3) Present case in front of focus group of 8 BRT experts. He defined the planning process as all activities, actions and decisions involved in the project development from initial concept through operationalization. The research offers how to move forward past the plan towards an intended outcome. [21]

Sarkar Debasis and Jatan Talati (2018), studied Integrated Mass Rapid Transit System for Smart City Project in Western India. The objective of this study is to study integrated transportation. It is one of the enablers of smart transportation which provides a seamless intercity as well as regional level transportation experience. The methodology adopted here is the collection of data through questionnaire

survey i.e. primary methods and secondary data was collected from the administrative offices of AMTS & BRTS. He used multiple regression analysis to find the results. On the basis of that, he concluded that the important factors for shifting to public transport were travel time, saving and comfort rating. Maximum coefficients were of the comfort ratings. [22]

Satsangi P.S. and Chelva L M in their paper - Alternate System of Urban Transport in Indian studied the alternative system of urban transport on the basis of cost and performance. They developed quick response to land-use transport planning model for Indian cities, cost efficient strategies, recognize urban transport as a function of urban planning, etc. They had chosen the secondary course of data collection from Indian statistical organization, GOI. They identified empirical demand with the help of demand function. They used gravity model to find out the models of the cities. They used discounted cash flow method to determine the cost and performance of total transport system. On the basis of their study, they recommended that cities with less than 1 million populations should use standard bus. Urban buses are suitable for cities with more than 1 billion population. Two bus-ways cannot be considered suitable. rather one MCRTS (electric train system) will be more appropriate because city center cannot take the proliferation of guide ways, which cannot be more than 40- 50% of network length. [23]

Shah Jay and Adhvaryu Bhargav (2016) studied Public Transport Accessibility Levels for Ahmedabad, India. The key aim of the paper is to measure PTAL map and initiate a discussion of its importance in application to understand and enhance accessibility. The collection of data is from the secondary source i.e. Google earth, AMC website, CEPT university, AMTS website, authors from the root information of MEGA website. The data was collected. They have adopted the methodology developed by London Borough of Hammersmith and Fulham and adopted by Transport of London. They used GIS mapping tool to generate a visual representation of public transport accessibility. And they concluded that the use of PTAL mapping enhanced planning practice. PTAL maps are an easy and smart representative tool for accessibility. PTAL maps are used by development planning authorities to integrate land use, use to increase the existing public transport system by recognising areas with poor accessibility, for the formulation of parking facilities etc. [24] Shah Shaishav D et al. (2015) in their paper assessed BRTS-Surat- as a Sustainable Urban Transport System. Their paper deals with the assessment of less preferred existing operational BRTS phase 1: Corridor-1. They studied the issues related with congestion and connectivity and trying to find out how such issues should be resolved by replanning. The methodology they adopted for that is inventory survey, field

survey through questionnaire, on board BRTS survey, and Para-Transit survey. On the basis of these surveys, they analyzed trip details, need for public transport, BRTS usage and Journey preference, fare and journey details, boarding and alighting details. They concluded that in this specific phase of BRTS in surat, BRTS-stops fail to cover major access locations over the route, private vehicle holders seek for parking facility and quick connectivity at the stops, perception of people to spend money rather than walking and large number of people in this route are laborer's and workers who preferred shared auto rickshaw along intermediate stops. [25]

Sharma Pankaj undertook a study of Sustainable transportation system in Ahmedabad and Delhi. He made an attempt to overview an all- inclusive set of indicators which were taken up by planners in order to help cities for developing an integrated and sustainable transportation system. To define sustainable development, he had taken three critical aspects as environmental aspects, economic aspects, and social issues to implement the decision. He compared the data with the objective of recommending measures to improve Urban Transport policy. On the basis of his research, he concluded that to achieve sustainability in the transportation, public transportation should be given priority, a multi-modal and integrated transit system should be created, monitoring the system through perfect planning mechanism, and adopting more economical, sustainable , and environment friendly technologies is necessary [26]

Singh Sanjay K (2005) reviewed the urban transportation issues especially those areas which were important for policy making. He collected the data from the various reliable sources of government agencies. On the basis of various variables which he used in his article, he concluded that the situation of urban transportation in Indian cities was deteriorating. Commuters were facing congestion, air pollution, and high level of accident risk. Therefore the policy should be designed in such a way that it reduces the need of travel by personalized mode by boosting public transportation system. There is a need to empower the urban local bodies to raise funds and coordinate the activities of various agencies involved in the provision of transport infrastructure in urban area. [27]

Singh Sanjay Kumar (2012) made - An economic analysis of Economic Profitability of Municipal Transport Undertakings in India with an objective to reveal that majority of the MTUs could not improve their economic profitability between 1990-91 and 2000-01 due to decrease in their productivity. He has collected samples from 9 municipal transport undertakings. He collected the data from secondary source i.e. from Performance statistics of STUs published for

the ASSOCIATION OF STATE ROAD TRANSPORT UNDERTAKINGS, NEW DELHI by the Central institute of road transport in India. For profitability, he uses price indices and quantity indices for the two different periods, he also uses the procedure proposed by Christensen and Jorgensen (1970). On the basis of his study, he concluded that majority of MTS's increased their output price at greater rate than that of input factor prices, but productivity decreases, hence economic profitability deteriorated. The traffic revenue never exceeds their respective operating cost. Few MTUs were able to raise their revenue but only for few years. BMTC is the only MTU which made accounting and economic profitability during these years. [28]

Singh Sanjay Kumar (2012) studied about the issues, challenges in the Urban Transport of India. This paper focuses on the issues and challenges from the policy making point of view. He reviewed the trend of vehicular growth and availability of transport infrastructure in Indian cities. His study period was between March 2000 and 2009. He used secondary data collection from the Ministry of Road Transport and Highways, Government of India. On the basis of this study, he concluded that public transportation has not been able to keep pace with rapid and substantial increase in travel demand. Therefore, there is a massive shift towards personalized transportation. Due to lack of effective public policy, it has its adverse effect in the form of congestion, air pollution and traffic accidents. Speed, service quality, convenience, flexibility, and availability favors adoption of private transportation, Public policy strategy should be designed in such a way that it reduces the need to travel by personalized modes and boost public transport system.

The author stated that Delhi was the first city in India to adopt privatization of bus services in a big way. When the private operators were associated with city services along with DTC buses, it was also consciously decided that each route would be run by both private as well as DTC buses. Simultaneously, neither traffic planning structures nor infrastructure facilities were created to manage the schemes. Likewise, enforcement structures were also not strengthened i.e. no provision was made for private bus operations to be watched by time- keepers and route inspectors etc. The experience had shown that the above mentioned policy-lacunae contributed significantly to the indiscipline in city bus services in Delhi. He also pointed out why there was a general feeling that a private operated bus was more economical than a DTC operated bus. A private operator will operate his bus only till such time when he gets some return out of his investment. As soon as the private operated bus becomes unremunerative or the margin of profit is reduced below the expectation, the private operator will withdraw his buses

irrespective of emergency or the need of the public. However, DTC has to operate its services irrespective of the financial constrains largely in social interest. Apart from this, DTC has to make provision for infrastructural facilities like depots, workshops, terminals, queue shelters etc. with investment on land, building and manpower and also for observance of various labor laws resulting into higher cost of manpower. The private operators on the other hand park their buses on streets and there is no parallel investment as such and the staff engaged by them work for extended hours on meagre salaries. The author also mentioned in this article that privatization would not release the pressure of the Government to allocate the capital resources for DTC. According to him, in most cases a single bus operator provides small proportion of the capital and major capital need is met by borrowing from the nationalized banks and financial institutions. Thus, it is the private ownership which is predominantly supported by public funds through public financial agencies. [29]

Vaidyanathan Vivek and Robin A King (2011) in their paper explained the institutional structure of urban transportation and setup affect the urban transportation in Bangalore city. On the basis of their secondary data collection from the various institutions which directly and indirectly affect the public transportation in Bangalore city, they concluded that state and central government boast of very good performance with significant powers to design transportation policies. However, the actual work and effectiveness is limited. [30]

III. RESEARCH METHODOLOGY

A. INTRODUCTION

The stages a researcher takes to explore his research problem are suggested by research methods, along with the reasoning behind each step. It demonstrates a systemic approach to resolving the research issue. The research methodology contains many distinct aspects, such as the many study kinds that are accessible for the planned study and the different research techniques that may be applied depending on the research topic.

The method of a given study defines the nature of the study, the methodology employed, and the research methods utilized for the gathering and evaluation of the pertinent data.

Investigating the material that is already out there on the planned topic is what the research design is all about. The exploratory research examines the literature and gathers the data needed for the study. Although the results of experimental studies are not immediately beneficial for

decision-making, a broad framework for planned study may be developed using the literature, data, and other material obtained from exploratory research.

The methodical and scientific method of doing research known as experimental research involves manipulating one or more variables while monitoring and measuring any changes in other variables. It is frequently employed in fields of science including sociology, psychology, physics, chemistry, and medicine, among others.

The term "statistical research" also applies to descriptive study. The fundamental objective of this form of research is to characterize the facts and features of the subject under investigation. Its key theoretical underpinnings are studying frequencies, averages, and other statistical computations.

The research approach used for the study is also made clear by the methodology. The many ways of coming up with strategies for doing research are known as research methodologies. A suitable approach is chosen for the planned study based on the type of investigation. According to Kothari (2006), there are three different sorts of research methods: laboratory, field, and library research. Analyzing old records and documents associated with the intended inquiry is part of the library research process. Observation, questionnaires, interviews, and surveys are used in the field study to get the necessary data. The research of random behavior, play, and role analysis is referred to as laboratory research.

The behavior and tools used to conduct research operations are referred to as research techniques. Examples of which include capturing data, taking notes, behavior, social and economic framework, employing audiovisual equipment, etc.

The literature review, data collecting, and data analysis in this study all make use of the descriptive and exploratory research approaches.

The required historical evidence, statistics, and other pertinent information are gathered using the library research technique. Browsing periodicals, books, manuals, databases, and websites is the proper research strategy used for the study. The goals of the study were selected based on this investigation, and hypotheses were developed to help the goals be met.

B. OBJECTIVES OF THE STUDY

The objectives of the study are outlined below:

1. To study and compare the operational performance of Urban Non-Rapid Transport & BRTS in Bhopal.
2. To study and compare the financial performance of Urban Non-Rapid Transport & BRTS in Bhopal.
3. To study and compare the process of income & expenditure of Urban Non-Rapid Transport and BRT system in Bhopal
4. To analyses the role of Municipal corporations and government bodies in the development of transport system in these cities.
5. To comprehend the elements influencing the effectiveness of the public transportation network.
6. The perspective of commuters toward various forms of public road transportation systems
7. To make suggestions for increasing the effectiveness of the public road transportation system.

C. SELECTED CITY: BHOPAL

In order to analyses the economic performance of rapid-transit and non-rapid transit systems in India, the city selected was Bhopal. There were two main parameters for selecting Bhopal for research.

- i. The city should have both speedy and non-rapid public transportation options.
- ii. Both Rapid and Non-Rapid public transport in that city have been in operation for quite a long time and were delivering good services.

D. DATA COLLECTION

The Comparing the economic effectiveness of two distinct types of public road transport service providers in a few Indian cities was the study's primary goal. This basically required the secondary-data from the financial-statements of these transport systems. The financial statements and annual reports of Bhopal City Buses and Bhopal-BRTS were extensively used to collect the required figures related to revenues, expenses, profits and losses. Besides the annual budgets, balance sheets, profit and loss accounts and cash flows of these service providers, a lot of qualitative information was collected through the interaction with the officials and commuters.

In order to understand the commuters' perception about the public bus services they use, a structured questionnaire was circulated among them to collect the primary data.

Responses of 400 commuters of rapid road transit in Bhopal were compared with responses of 400 commuters of

non-rapid road transit system. Thus, a total of 800 respondents were interviewed in all.

The commuters were asked about their perception about the following facets of the road public transport system they generally use.

1. The Quality of Buses
2. The Timeliness of Buses
3. The Safety during Travel
4. Frequency of Buses
5. Adequacy of Routes
6. The Use of Technology
7. The Bus Fares
8. The Conduct of Bus Crew

E. TIME PERIOD

The financial performance of these public transport systems was analyzed for a two-year period. 2016-17, 2017-18, 2018-19. The primary data was collected in the month of September, 21.

F. HYPOTHESES OF THE STUDY

There is no association between the type of public road transport system and commuters' perception about various aspects of bus service in Bhopal.

G. STATISTICAL TOOLS FOR ANALYSES

Simple tabular displays of revenues, expenses, profits, and losses are used to assess and compare the financial performance of two public road transport systems in each of the chosen cities.

In order to determine and compare the commuter's perception about the bus services which they use whether rapid or non-rapid road transit, the statistical tool of chi-square is used. Besides, their responses are presented through doughnut diagrams.

χ^2 test as a test of independence: chi square test has been used to find out whether two or more attributes are associated or not. It suggests that it is possible to determine whether or not two or more traits are independent. To determine if two traits are related to one another or not (i.e., whether they are independent or not), a null hypothesis that there is no association between the attributes under study (i.e. the two attributes are independent) has been formulated and tested at a certain level of significance (generally 5%) for certain degrees of freedom. If the calculated χ^2 is greater than

the tabulated χ^2 then the null hypothesis that the two attributes are not associated is rejected which leads to the conclusions that the two attributes under study are associated with each other i.e., they are not independent of each other. In other words, they are dependent on each other. re independent of each other.

H. LIMITATIONS OF THE STUDY

The performance of the rapid and non-rapid public road transport systems is compared for only four selected cities and for a period of only three years. As a result, the conclusions may not be valid for the entire country.

Similarly, the commuters' perception about the two types of bus services is based on a total sample of eight hundred respondents only. Two hundred from each selected city. As a result, the limitations related to sampling and primary data will also apply to the current study.

IV. RESULTS

I. A COMPARATIVE ANALYSIS OF RAPID AND NON-RAPID TRANSPORT SYSTEM IN BHOPAL

The current research tries to compare the economic performance (measured by revenues, expenses, profits and losses) and service quality performance (measured through the commuters' perception about the quality of services) of the rapid road transit system with non-rapid road transit system in Bhopal.

The first part of this chapter compares the economic performance of rapid and non-rapid road transport systems in the selected cities whereas the second part compares the service quality of the two types of road transits.

There are two main types of intra-city bus services in Bhopal; the non-rapid city buses run by BCLL and the rapid road transit services. Following tables display the annual expenses, revenues and profit/losses for both the types of bus services.

II. A COMPARISON OF THE OVERALL SERVICE QUALITY OF RAPID AND NON-RAPID BUSES BHOPAL

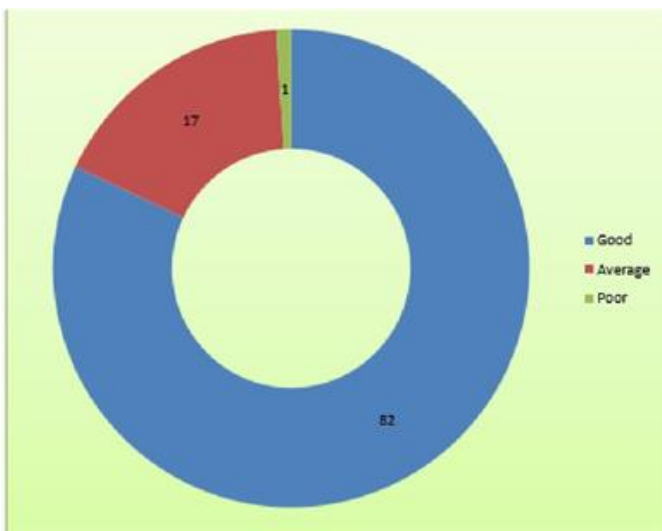
Table -1 Perception about the Quality of Buses-Bhopal

RATING	NON-RAPID ROAD PUBLIC TRANSPORT	RAPID ROAD TRANSIT SYSTEM

GOOD	50	82
AVERAGE	40	17
POOR	10	01

Out of the 100 sample commuters who travelled by non-rapid road transit (BCLL- CITY BUSES) in Bhopal, 50 considered the quality of buses to be good, 40 considered it to be average and 10 considered it to be poor.

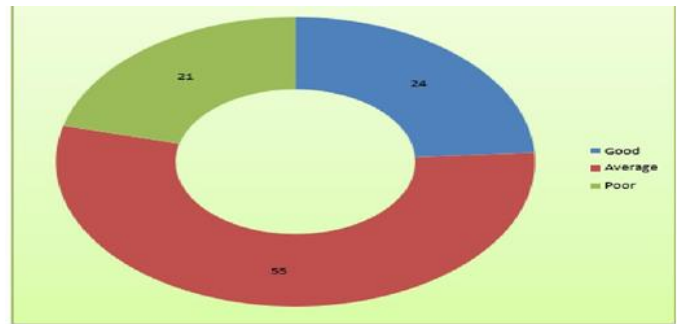
On the other hand, out of the 100 sample commuters who travelled by rapid road transit (BRTS-MY BUS) in Bhopal, 82 considered the quality of buses to be good, 17 considered it to be average and 01 considered it to be poor.



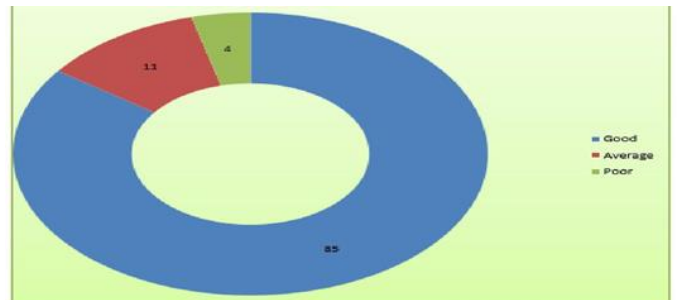
Graph-1 Perception about the Quality of Buses- Bhopal (Rapid)

Table -2 Perception about Bus Frequency-Bhopal

RATING	NON-RAPID ROAD PUBLIC TRANSPORT	RAPID ROAD TRANSIT SYSTEM
GOOD	24	85
AVERAGE	55	11
POOR	21	04



Graph-2 Perception about the Use of Technology-Bhopal (Non-Rapid)



Graph-3 Perception about the Use of Technology- Bhopal (Rapid)

Out of the 100 sample commuters who travelled by nonrapid road transit (BCLL- CITY BUSES) in Bhopal, 24 considered the use of technology in buses to be good, 55 considered it to be average and 21 considered it to be poor.

On the other hand, out of the 100 sample commuters who travelled by rapid road transit (BRTS-MY BUS) in Bhopal, 85 considered the use of technology in buses to be good, 11 considered it to be average and 4 considered it to be poor.

V. DISCUSSION AND CONCLUSION

The chapter is divided into two sections. The first section presents the key findings of the study whereas the second section provides recommendations for improving the performance of public-sector road transport system in the selected cities of the country.

- Section-1

This research attempts to make a comparative analysis of the rapid road transit system and non-rapid road transit system in Bhopal. The economic performance is measured by revenues, expenses, profits and losses and service quality performance as measured through the commuter’s perception about the quality of bus services.

BHOPAL AS A CITY

Bhopal is one of the cities which has both; rapid as well as non-rapid road transit systems run by the state. Bhopal City Bus is the non-rapid road transport service whereas Bhopal-BRTS (My Bus) is the rapid road transit system. Both are managed by Bhopal Municipal Corporation. Following are the main findings regarding the public road transportation in Bhopal.

Findings about the economic performance

1. Both non-rapid (Bhopal City Bus) and rapid (Bhopal-BRTS) road transport systems in Bhopal are making considerable losses.
2. However, the total losses of Bhopal City Buses were greater than the losses of BRTS.
3. The total loss of Bhopal City Buses during 2018, 2019 and 2020 was around Rs. 43 crores per annum on average.
4. The total expenses of city buses for the selected three years were around Rs. 94 crores on average.
5. The total revenue of Bhopal City Buses for the selected three years was around Rs. 50 crores on average.
6. The total loss of Bhopal-BRTS for the same period was around Rs. 21 crores per annum on average.
7. The total expenses of Bhopal-BRTS for the selected three years were around Rs. 61 crores on average.
8. The total revenue of Bhopal BRTS for the selected three years was around Rs. 41 crores on average.
9. The main reasons for higher losses to Bhopal City Buses as compared to the BRTS are limited number of passengers, competition from local auto rickshaws and lower bus fares.
10. The main reasons for losses to BRTS are stagnant passenger traffic and competition from Shared Rickshaw Services (Shuttle). Lot of people prefer these Shuttles as compared to BRTS buses as their frequency is very high, waiting time is very less and they are more hassle free.

Findings about the Service Quality

The association between the type of public transport and the commuters' perception about the quality of bus service in Bhopal was determined by using the statistical tool of chi-square. Following are the findings related to the city of Bhopal.

1. The 'quality of rapid transit (Bhopal-BRTS) buses' is significantly better as compared to the 'quality of

non-rapid transit (Bhopal City Buses) buses' as per the commuter's perception. Thus, the null hypothesis (Ho) that there is no association between the type of public transport and quality of buses stands rejected.

2. The 'timeliness of rapid transit (Bhopal-BRTS) buses' is significantly better as compared to the 'timeliness of non-rapid transit (Bhopal City Buses) buses as per the commuter's perception. Thus, the null hypothesis (Ho) that there is no association between the type of public transport and timeliness of buses stands rejected.
3. The 'safety in rapid transit (Bhopal-BRTS) buses' is significantly better as compared to the 'safety in non-rapid transit (Bhopal City Buses) buses as per the commuter's perception. Thus, the null hypothesis (Ho) that there is no association between the type of public transport and safety in buses stands rejected.
4. The 'Bus-Fare of rapid transit (Bhopal-BRTS) buses' is significantly higher as compared to the 'bus-fare of non-rapid transit (Bhopal City Buses) buses as per the commuter's perception. Thus, the null hypothesis (Ho) that there is no association between the type of public transport and bus-fare stands rejected.
5. The conduct of bus-crew in rapid transit (Bhopal-BRTS) buses' is not significantly better as compared to the 'conduct of bus-crew of non-rapid transit (Bhopal City Buses) buses as per the commuter's perception. Thus, the null hypothesis (Ho) that there is no association between the type of public transport and quality of buses stands accepted.
6. The 'frequency of rapid transit (Bhopal-BRTS) buses' is significantly higher as compared to the 'frequency of non-rapid transit (Bhopal City Buses) buses as per the commuter's perception. Thus, the null hypothesis (Ho) that there is no association between the type of public transport and bus-frequency stands rejected.
7. The 'use of technology in rapid transit (Bhopal-BRTS) buses' is significantly higher as compared to the use of technology in non-rapid transit (Bhopal City Bus) buses as per the commuter's perception. Thus, the null hypothesis (Ho) that there is no association between the type of public transport and use of technology in buses stands rejected.

REFERENCES

- [1] Agarwal PK, Sharma Anupama, Singh AP, An Overview on Bus Rapid Transit System, Journal of Engineering Research and Studies Vol. I Issue: II, 2010.
- [2] Arora Sameep and Prashanth proceedings of umi 2012, JRB, 2012.

- [3] Bhattacharya Shrimoyee, Sonali, Anushree Patro, Sujaya Rathi Creating Inclusive Cities: A Review of Indicators for Measuring Sustainability for Urban Infrastructure in India, *Environment and Urbanization ASIA*, Vol. 7 Issue: 2, 2016.
- [4] Chaudhari Dron and Prof N.D. Haziani, Traffic Impact Analysis of BRTS- A case study of Ahmedabad BRTS, *IJEDR*, Vol. 2 Issue 2, 2014.
- [5] Dr. Harish M Urban Transport and Traffic Management- For Sustainable Transport Development in Mysore City ', *ITJC Journal*, Vol.: Issue: 2013.
- [6] Dr. Verma Ashish, V. Harsha, Mehvish Shah Urban Transport Policies in India in context to Climate Change: An International Perspective' 10th Annual Conference of Knowledge Forum Venue: National Institute of Advanced Studies (NIAS), Bangalore 27-28, November, 2015
- [7] Electricwala Fatima, Rakesh Kumar Framework of public bus transit in Indian cities ', *International Journal of Sustainable Environment*, 2013.
- [8] Elif Can Cengiz Bus rapid transit: An environmental friendly transport solution for Istanbul' *The International Journal of Transport, Development and Integration*, Volume 1-Issue 1, 2017.
- [9] Gaurkar Vaibhav Systematic Organization of Para-transit System in Context of Public Transport System: A Case Study of Surat City' *Journal of Engineering Research and Applications* Vol. 3, Issue 6, 2013.
- [10] Getachew Legese, Pablo Evia, Daniel Tutu Benefoh, Comparative assessment of success and failure factors for implementation of bus rapid transit system in Accra & Bogota, Interdisciplinary term paper, ZEF Bonn, 2014
- [11] Gupta Kanika and Ved Vyas Jayprakash Dwivedi BRTS: An Effective Mode of Public Transport, *International Journal of Innovative Engineering Research (IJIER)* Vol. 1 Issue 1, 2014.
- [12] Jishnu Gohel, A Comparative Review of BRT System Introduced in Ahmedabad, *IJEDR*, Vol. 3 Issue 1
- [13] John Pucher, Hyungyong Park, and Mook Han Rutgers Public Transport Reforms in Seoul: Innovations Motivated by Funding Crisis', *Journal of Public Transportation*, Vol.: 8, Issue: 5, 2005.
- [14] Khaturia Ankit, Manoranjan Parida, Ravi Shekhar and Anshuman Sharma A review of bus rapid transit implementation in India' *Cogent Engineering*, Vol. 3 Issue: 1, 2016.
- [15] Kumari Priti and Pooja Podar, Case Study of BRTS (Jamnagar) and AMTS (Ahmedabad) *International Journal for Scientific research and Development*, Volume: 4, Issue: 2, 2016.
- [16] Kushwaha Aditya, Akshat Man Gupta, Yogesh Rajput, Traffic Impact of BRTS-A case study of Indore BRTS, *IJEDR* | Volume 6, Issue, 2018.
- [17] Mahadevia Darshini, Rutul Joshi, Abhijit Datey A Sustainable Urban Transport Panacea? Ahmedabad's BRT System, *Economic and Political Weekly*, Volume: 48 Issue: 48, 2013.
- [18] Matariya Rahul D, P.A. Shinkar & Rahul M Kasundra (2017) Performance Evaluation of Bus Rapid Transit System ', *IJSRD, International Journal for Scientific research and Development*, Vol. 5, Issue: 1, 2017.
- [19] Nistor Filip and Catalin C. Popa The Role of Transport in Economic Development' *Mircea cel Batran! Naval Academy Scientific Bulletin*, Vol. XVII, No. 2, 2014.
- [20] Reddy B. Sudhakara & P. Balachandra Dynamics of Urban Mobility: A Comparative analysis of megacities of India' *Indira Gandhi Institute of Development Research, Mumbai*, December, 2010 <http://www.igidr.ac.in/pdf/publication/WP-2010-023.pdf>
- [21] Rizvi, A. How planning process impacts bus rapid transit outcomes: a comparison of experiences in Delhi and Ahmedabad, India. *Columbia University*, 2014.
- [22] Sarkar Debasis, Jatan Talati Integrated Mass Rapid Transit System for Smart City Project in Western India', *International Journal of Urban and Civil Engineering* Vol: 12, No:5, 2018.
- [23] Satsangi P.S. & L.M. Chelva Alternative Systems for Urban Transport in India, *Journal of Advanced Transportation*, Vol. 27, No. 3, 1993.
- [24] Shah Jay & Bhargav Adhvaryu Public Transport Accessibility Levels for Ahmadabad, India' *Journal of Public Transportation* 19(3):19-35, 2016.
- [25] Shah Shaishav D, Patel Ravi J. Jain Saurabh Appraisal Study of BRTS Surat-A Sustainable Urban Transport', *IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)*, Vol.12, Issue 4 Ver. IV, 2015.
- [26] Sharma Pankaj, A Study of Sustainable Transportation System in Ahmedabad and Delhi, *International Journal of Advance Research, Ideas and Innovations in Technology*, Vol. 3 Issue: 6, 2017.
- [27] Singh Sanjay K Review of Urban Transportation in India *Journal of Public Transportation*, Vol. 8, Issue: 1, 2005.
- [28] Singh Sanjay Kumar Urban Transport in India: Issues, Challenges, and the Way Forward *European Transport/Transport Europei*, Issue 52, Paper n 5, 2012.
- [29] Singh Sanjay Kumar An analysis of Economic Profitability of Municipal Transport Undertakings in India' *Indian Journal of Transport Management*, 26 (4) , 2012.
- [30] Vaidyanathan Vivek and Robin A King Institutional Analysis of Urban Transportation in Bangalore, *The 4th Annual International Conference on Next Generation Infrastructures*, Virginia Beach, Virginia, November 16-18, 2011