

AN ANALYSIS OF THE DEMAND FOR URBAN PUBLIC TRANSPORTATION: A CASE STUDY OF BHOPAL

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ABSTRACT

Due to the rising number of individuals who own cars and use limited transportation, especially in cities with populations of one to two million, the development of the automotive culture has had a significant impact on all metropolises' highways in India's million-plus regions. The main cause of this is the shockingly low ridership of the public transport system, which is a result of poor service quality and lengthier journey times. Examining Bhopal's rapid and non-rapid road transport networks is the goal of this study. The evaluation of economic strength and service quality, as determined by commuter judgements of bus service quality, is done through the analysis of revenues, costs, profits, and losses. This can support the development of creative solutions to problems like increased commuter traffic, power consumption, and productivity gains. It can also help to make alternative public transportation options more accessible to the general public, help them meet equity goals, and increase their financial efficiency. Estimating the actual transport demand is another way to measure a new method because it allows the most practical and suitable framework to be chosen.

1 INTRODUCTION

1.2 GENERAL

The Latin term "Transport are," from which the English word "transport" is derived, means "across or the other side" and "port are" means "to carry." Thus, to convey something is to carry the other side. "Transportation is the process of carrying goods and persons from one place to another," according to the definition given above. Transport has a role in the diffusion of development and the blending of cultures. I find it fascinating to quote the author's opinion about the importance of travel in the modern world as a whole. One of the most important and essential human institutions is transportation. It advances with humankind's pursuit of progress and regresses with the dissolution of societal hierarchy.

Without transportation, humans would not be able to interact with the outside world and would therefore lack the characteristics of civilization. In a real sense, the transporter is the one who created civilization. "In every stage of advanced civilization, one of the most important activities of men has been the transportation industry, which specialises in the simple movement of people and goods from one place to another." With fresh developments in the domains of ways, means, motive power, engineering techniques, organisations, legal enactments, and social, economic, and political considerations, the significance of transportation is growing daily. These days, the advancement of transport is linked to its commercial and socioeconomic significance. Transportation turns out to be a tool for cultural evolution. Thus, a civilization devoid of a sophisticated transportation infrastructure becomes archaic.

An excellent statement about the general significance of transport in the modern world may be found here, attributed to a well-known author. One of the most important basic human institutions is transportation. Its history begins from the beginning of written history and extends further. It advances with humankind's pursuit of progress and regresses with the dissolution of societal hierarchy. Individuals without access to transportation would be isolated from the outside world and, as a result, lack the characteristics of civilization.

1.2 MEANING OF TRANSPORT & TRANSPORTATION

Transport is simply the movement of people or goods from one place to another. Different people have given different definitions of transportation. A few of them are stated as under.

"Transportation is an indispensable part of a culture, as hall mark of civilization". "A vehicle or system such as buses and trains etc is the means of getting from one place to another."

"The growth of the ability & need to transport large quantities of goods or number of people over long distances at high speeds in comfort and safety has been an index of civilization & in particular of technological progress".

1.3 EVOLUTION OF TRANSPORTATION

Walking, jogging, and swimming were the men's primary modes of transportation when they initially began living a nomadic lifestyle. As the evolutionary process progressed, humans became specialised in gathering food and began

domesticating animals. Following that, men transitioned from being food gatherers to food producers and began learning the craft of agriculture. It's a novel approach to assigning greater strength to creatures with greater mobility. As a result, man employed tamed animals for travel and for moving large objects from one location to another. They travel faster and require less time to move both people and goods. The development of the wheel brought about a revolution in transportation. Animal transportation became more effective after wheels were invented. Until the Industrial Revolution (around the eleventh century BC), the only effective mode of transportation in the world was water transportation. For the longest time, the only effective means of moving big loads over great distances was water transport, which includes both rowed and sailed vessels.

When roads were initially established, commodities were transported over dirt pathways that frequently followed game trails by animals like horses, which were tamed in the fourth or third millennium BCE, oxen, which date back to approximately 8000 BCE, or humans. Paved roadways were built by numerous ancient civilizations, such as the Indus Valley Civilization and Mesopotamia. The Persian and Roman empires constructed stone-paved highways in classical antiquity to facilitate armies' rapid movement. Such highways were kept dry by subterranean crushed stone roadbeds. Canoes made from tree trunks were the earliest watercraft, and later on, the mediaeval Caliphate constructed far-paved roadways. Ships that were either rowed, propelled by the wind, or a mix of the two were used to move goods over water in the past. Because of how important water is, most cities that developed as hubs for trade are found near rivers or the coast, sometimes where two bodies of water converge. Production and consumption tended to concentrate as near to one another as possible prior to the Industrial Revolution because transportation remained expensive and slow. Many inventions made during the Industrial Revolution in the 19th century drastically altered the transportation industry. The development of the steam engine and its subsequent use in rail transportation made land transportation independent of the muscles of humans or animals. Telegraphy also made communication instantaneous and unreliant on the movement of physical objects. Both capacity and speed rose quickly. The invention of the steam ship in the 19th century also accelerated international travel.

Around 1900, the invention of the combustion engine and the vehicle increased road transportation's competitiveness, giving rise to mechanical private transportation. Using macadam, the first "modern" roadways were built in the 19th century. Concrete and tarmac eventually took over as the most used pavement materials. The Wright brothers successfully exhibited the first controllable aeroplane in 1903, and following World War I (1914–1918), aircraft emerged as a quick and efficient means of long-distance people and cargo transportation.

Following World War II (1939–1945), short-haul passenger services and freight on rail and water were replaced by automobiles and aeroplanes, which gained greater market share in the transportation sector. The 1950s saw the start of scientific spaceflight, which grew quickly until the 1970s, when interest began to decline. Globalisation was aided in the 1950s by the development of containerisation, which greatly increased freight transport efficiency. With the introduction of the jet engine in the 1960s, international air travel became much more accessible. Rail and water transport lost relative importance as cars and roads increased in number. Other than aeroplanes, high-speed rail in Asia and Europe began drawing passengers on long-haul routes once the Shinkansen was introduced in Japan in 1964. Aqueducts, bridges, canals, railroads, highways, and tunnels were primarily held by private joint stock companies in the early years of American history. The majority of this kind of transportation infrastructure was taken over by the government in the late 19th and early 20th centuries, and Amtrak was created to nationalise intercity passenger rail service. But recently, there has been some momentum behind the privatisation of infrastructure, including roads.

2 LITERATURE REVIEW

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 analyse 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]

3 RESEARCH METHODOLOGY

3.1 INTRODUCTION

Research methodology refers to the several approaches a researcher takes when examining his research problem and its rationale. It provides a methodical approach to solving the research problem. The research methodology encompasses many distinct aspects, such as the range of research types that are available for the planned study and the range of research procedures and techniques that can be employed based on the specific research topic. A study's methodology makes clear the kind of study that was done, the approach that was taken, and the methods that were employed for gathering and analysing the pertinent data that was gathered.

Examining the information that is currently accessible in relation to the planned study is the focus of exploratory research. Reviewing existing research and data needed for the study is the focus of exploratory research. Although the results of exploratory research are not immediately helpful for making decisions, a broad framework for planned study can be developed using the literature, data, and other material obtained from exploratory research. In this study, the literature review, data collecting, and information analysis are conducted using the exploratory and descriptive research approaches.

The required historical facts, data, and other pertinent information are gathered using the library research approach. Accessing journals, books, manuals, databases, and websites is the proper research methodology used for this study. The investigation served as the basis for deciding on the study's aims, which were then supported by the formulation of hypotheses.

Research methodology suggests various steps adopted by a researcher in studying his research problem along with the logic. It shows a way to solve the research problem systemically. The research methodology has many dimensions like various types of researches available for the proposed study, different research methods and techniques, which can be used according to the research problem.

The methodology of a particular research clarifies the type of research conducted, the type of method used and the research techniques adopted for the collection and analysis of the collected relevant information.

The exploratory research is concerned with the study of available information related to the proposed study. The exploratory research deals with the review of available research and data required for the study purpose. The results of the exploratory research are not directly useful for decision-making but on the basis of literature, data and other information availed through exploratory research, a broad framework of proposed research can be prepared.

Experimental research is a systematic and scientific approach to research in which the researcher manipulates one or more variables, and controls and measures any change in other variables. It is commonly used in sciences such as sociology and psychology, physics, chemistry, medicine etc.

Descriptive research is also called as statistical research. The main goal of this type of research is to describe the data and characteristics about what is being studied, the idea behind this type of research is to study frequencies, averages, and other statistical calculations.

Methodology also clarifies the research method adopted for the study. Research methods are the different methods of generating techniques of conducting research. Based on type of research, a suitable method is decided for the proposed research. As per Kothari (2006), the types of research methods are Library Research, Field Research and Laboratory Research. Library research method involves analysis of historical records and documents relating to the proposed research. The field research involves the collection of the required information through observation, questionnaire, interview and survey. Laboratory research refers to the study of random behavior, play and role analysis.

Research procedures encompass the methods and tools employed in doing research, such as data collection, note-taking, behaviour analysis, social and economic context, and usage of audiovisual equipment, among other things. In this study, the literature review, data collecting, and information analysis are conducted using the exploratory and descriptive research approaches.

The required historical facts, data, and other pertinent information are gathered using the library research approach. Accessing journals, books, manuals, databases, and websites is the proper research methodology used for this study. The investigation served as the basis for deciding on the study's aims, which were then supported by the formulation of hypotheses.

3.2 HIGHLIGHT OF THE INVESTIGATION KEY TARGETS

The objectives of the study are outlined below:

1. To investigate and contrast Bhopal's Urban Non-Rapid Transport and BRTS operational performance.
2. To research and contrast Bhopal's Urban Non-Rapid Transport and BRTS's financial results.
3. To investigate and contrast the revenue and expense processes of BRT and urban non-rapid transit in Bhopal.
4. To examine how government agencies and municipal businesses contributed to the growth of these cities' transport networks.
5. To comprehend the elements influencing how well the public road transport system performs.
6. To comprehend commuters' opinions regarding various public road transport options
7. To suggest actions to enhance the functionality of the public road transport system.

SELECTED CITY: BHOPAL

Bhopal was the chosen city to examine the financial performance of India's rapid-transit and non-rapid transit systems. The selection of Bhopal for research was based on two primary criteria.

- i. The city needs to provide both non-rapid and quick public road transit.
- ii. The city's public transport system, both rapid and non-rapid, has been operating for a while and has provided good services.

DATA COLLECTION

Comparing the financial performance of two distinct categories of public road transport service providers in a few Indian cities was the primary goal of the study. In essence, this called for the secondary information from these transit networks' financial statements.

To get the necessary data on sales, expenses, earnings, and losses, Bhopal City Buses and Bhopal-BRTS's financial statements and annual reports were heavily consulted. In addition to these service providers' annual budgets, balance sheets, profit and loss statements, and cash flows, a great deal of qualitative data was gathered via interactions with commuters and authorities.

To gather primary data, a structured questionnaire was distributed to commuters to determine their perceptions of the public bus services they utilise.

400 USERS OF BHOPAL'S QUICK ROAD TRANSIT SYSTEM PROVIDED RESPONSES, WHICH WERE COMPARED TO 400 USERS OF THE NON-RAPID ROAD TRANSIT SYSTEM. AS A RESULT, 800 RESPONDENTS IN ALL WERE QUESTIONED.

4 RESULT AND DISCUSSION

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

The goal of the current study is to compare the rapid road transit system's (measured by revenues, expenses, profits, and losses) and non-rapid road transit system's (measured by commuter perceptions of service quality) economic and service quality performances in Bhopal.

This chapter's first section analyses the financial performance of the rapid and non-rapid road transport systems in the chosen cities, and its second section compares the two road transit systems' service quality.

BHOPAL

In Bhopal, there are two primary intra-city bus services: the rapid road transit services and the non-rapid city buses operated by BCLL. The yearly costs, earnings, and profit/loss for the two types of bus services are shown in the tables that follow.

Table 1 Perception about Timeliness-Bhopal

RATING	NON-RAPID ROAD PUBLIC TRANSPORT	RAPID ROAD TRANSIT SYSTEM
GOOD	48	87
AVERAGE	19	9
POOR	33	4

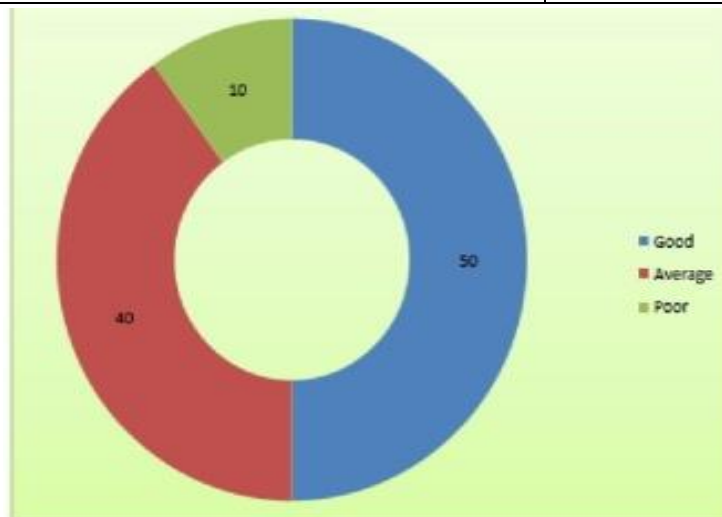


Figure 1 Perceptions about the Quality of Buses- Bhopal (Non-Rapid)

Table 2 Perception about the Conduct of Bus-Crew-Bhopal

RATING	NON-RAPID ROAD PUBLIC TRANSPORT	RAPID ROAD TRANSIT SYSTEM
GOOD	81	92
AVERAGE	14	6
POOR	05	2

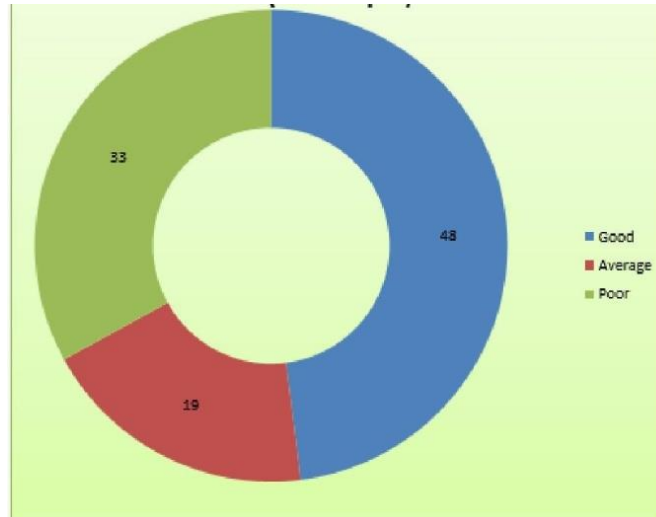


Figure 2 Perception about Timeliness-Bhopal (Non-Rapid)

Of the 100 commuters in the sample that took the BCLL-CITY BUSES, a nonrapid road transport system in Bhopal, 81 thought the bus crew's behaviour was good, 14 thought it was average, and 5 thought it was terrible. However, of the 100 sample commuters who used Bhopal's rapid road transport system (BRTS-MY BUS), 92 thought the bus crew's behaviour was excellent, 6 thought it was mediocre, and 2 thought it was bad.

Table 3 Perception about Bus Frequency-Bhopal

RATING	NON-RAPID ROAD PUBLIC TRANSPORT	RAPID ROAD TRANSIT SYSTEM
GOOD	65	85
AVERAGE	22	9
POOR	13	6

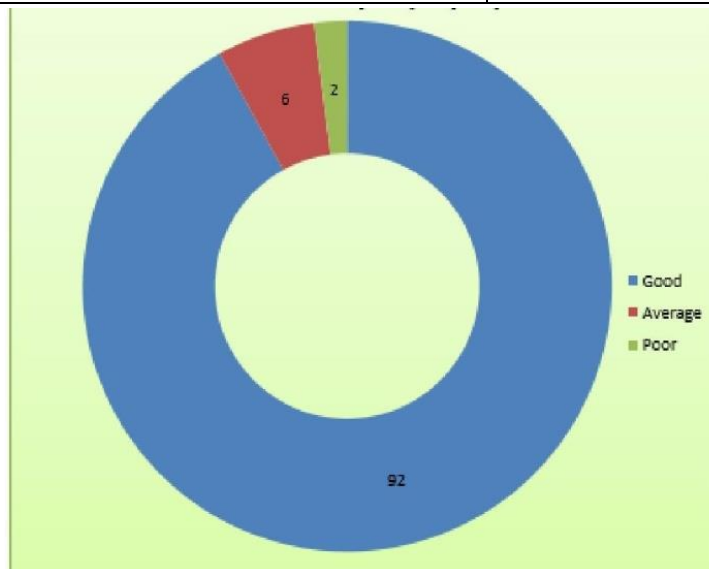


Figure 3 Perception about the Conduct of Bus- crew-Bhopal (Rapid)

Of the 100 sample commuters that used Bhopal's non-rapid road transport system (BCLL-CITY BUSES), 65 thought the frequency of the buses was good, 22 thought it was average, and 13 thought it was poor. However, of the 100 sample commuters who used Bhopal's rapid road transport system (BRTS-MY BUS), 85 thought the frequency of the buses was good, 09 thought it was average, and 06 thought it was poor.

Table 4 Perception about Bus Frequency-Bhopal

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

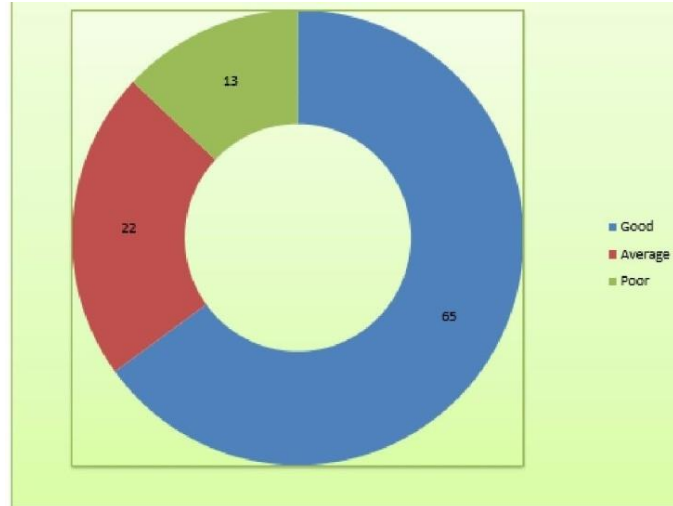


Figure 4 Perception about the Bus Frequency-Bhopal (Non-Rapid)

Of the 100 commuters in the sample who took the BCLL-CITY BUSES, a nonrapid road transport system in Bhopal, 24 thought the usage of technology in the buses was acceptable, 55 thought it was average, and 21 thought it was poor. However, of the 100 sample commuters who used Bhopal's rapid road transport system (BRTS-MY BUS), 85 thought the usage of technology on buses was good, 11 thought it was mediocre, and 4 thought it was bad.

ASSOCIATION BETWEEN THE TYPE OF PUBLIC ROAD TRANSPORT AND COMMUTERS' PERCEPTION

This section looks into whether commuter perceptions of the quality of bus service are influenced by the type of public transport available.

The relationship between the kind of public road transport and commuter perceptions of the general calibre of bus services has been examined using the chi-square test.

Analysis has been done on how commuters see the following aspects of bus services.

1. Bus (vehicle) quality;
2. timeliness;
3. safety
4. Sufficient Routes
5. Bus Tickets
6. Bus Crew Conduct
7. Bus Frequency
8. Technology Use

Research has been done on the relationship between commuter perceptions and the kind of public road transport available in Bhopal.

5 CONCLUSIONS AND FINDINGS

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.

5.1 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.

5.2 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.
The 'adequacy of routes of non-rapid transit (Bhopal City Buses) buses' is significantly better as compared to the 'quality of rapid transit (Bhopal-BRTS) bus' as per the commuter's perception. Thus, the null hypothesis (Ho) that there is no association between the type of public transport and adequacy of routes of 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.

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.

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