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AN EVALUATION OF BUS RAPID TRANSIT SYSTEM IN INDORE

Bhagwati Charan Shukla (Ph.D Scholar)
APSU Rewa

Dr. Sanjay Shanker Mishra
Professor -TRS College Rewa

ABSTRACT

In Madhya Pradesh, the only city that currently operates BRT is Indore and Bhopal. There are researches that focus on different BRT systems in the world, yet there has not been a comprehensive, systematic and comparative evaluation of the BRT experience in Madhya Pradesh. There seems to be an urgent need to study this BRT investment, with a particular focus on planning, operation and ridership characteristics with a comparative approach. This Paper analyses the BRT corridor in Indore and answers the question whether I-Bus in Indore is a success or not. In order to understand the criteria for defining success, planning, operation and ridership characteristics are identified based on the previous. The study sets the criteria in planning, operation and ridership of BRT systems drawn by previous studies and answers by people who were involved in these projects. The study reveals strength and weaknesses of the Indore I-bus. The findings provide lessons both for the future extensions of the BRT in Indore and for other cities that may consider implementing this transit technology.

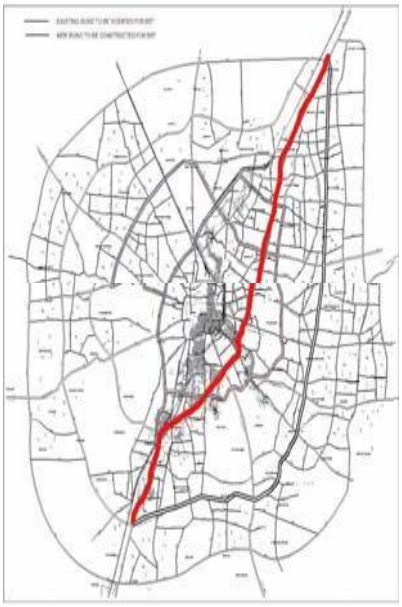
Key words: Bus Rapid Transit, Indore I-Bus, public transport.

INTRODUCTION

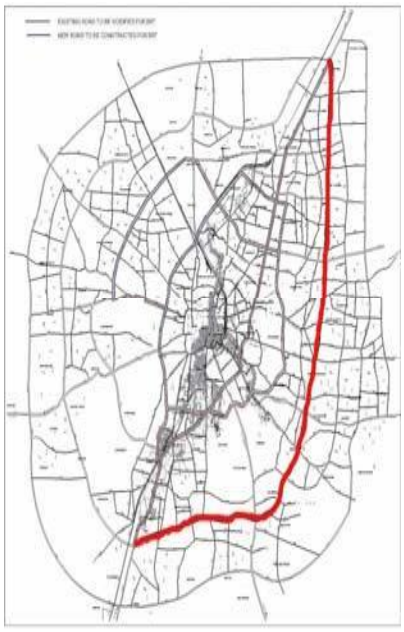
The **BRTS** or **Ahilya Path** is the Bus Rapid Transit System for the city of Indore, Madhya Pradesh by AICTSL. It became operational from May 10, 2013. The Indore BRTS project started in 2007 under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM). It involves the participation of the Governments of India and Madhya Pradesh, and the World Bank.

Bus Rapid Transit System (BRTS) is an innovative, high capacity, lower cost public transport solution that can significantly improve urban mobility. Public Transport System in most Indian cities is rapidly deteriorating because of the increasing travel demand and inefficient transportation system. There are various problems related with public transport such that tremendous increase in number of accidents, Environmental degradation, Congestion, Overcrowding due to inadequate system, Frequency of service and schedule is not strictly adhered. The problem of pollution, safety and inefficiency have reached at a alarming level in most of the major cities in India due to unabated growth of its population -both of people and motor vehicles, combined with inefficient public transport system and poor enforcement of environmental laws etc. Thus, there is a great need to ensure clean, efficient, affordable, effective and safe public transportation system and for this Bus Rapid Transit System could become an appropriate solution. Bus Rapid Transit (BRT) Systems have emerged as one of the important modes of public transport. They are Motorized Transport comparatively flexible, easily accessible, and efficient and also cost effective in terms of being able to transport a large number of people (rather than vehicles). BRT systems can easily be customized to community needs and incorporate state-of-the-art, low-cost technologies that result in more passengers and less congestion.

BRTS – PROPOSED ROUTES

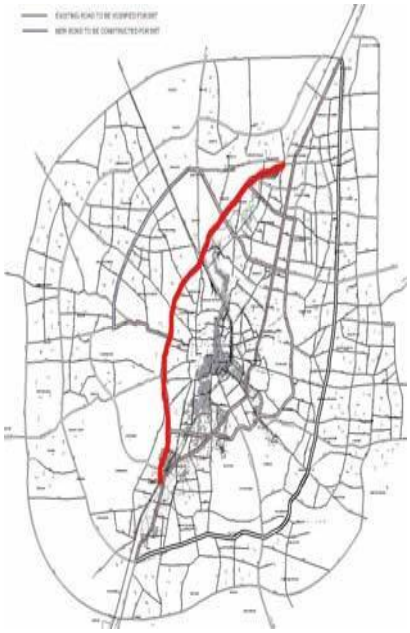


A. B. road Corridor

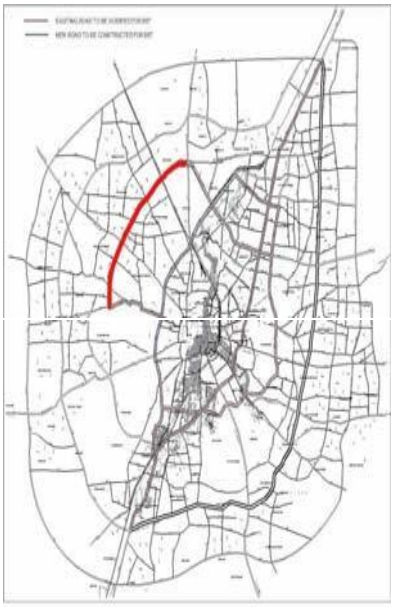


Eastern Ring road corridor

M.R.10 Corridor 8.71 Km



Western Ring road corridor



R.W. 2 Ujjain Road to airport

River Side corridor

LITRATURE REVIEW

This research reviews the planning, implementation, and initial operation and financial viability of bus rapid transit systems (BRTSs) in Indore. The initial four cities that received funds under the Jawaharlal Nehru National Urban Renewal Mission (JnNURM) are reviewed: Ahmedabad, Indore, Jaipur, and Pune. JnNURM is a Government of India (GOI) program to support state and local investment in urban development. GOI also adopted a National Urban Transport Policy (NUTP). Indian states and municipalities are required to follow NUTP rules and regulations, including clear incentives for the implementation of public transport systems and non-motorized infrastructure projects, as opposed to general road construction or expansion projects. This paper describes relevant characteristics of the BRTs being implemented in indore city and provides comments on planning, design, and institutional arrangements. The projects are an important departure from traditional urban transport practices in Indian cities: they prioritize the use of public transport and non-motorized modes. Nevertheless, this preliminary survey suggests that in most cases a strong focus remains on infrastructure, while other elements of BRTs receive less attention. As a result, the full potential of BRTs is not necessarily attained. Regarding planning activities, it is noted that demand estimation and operations design could have been more elaborate. This paper provides general recommendations for planners, decision makers, and funding agencies in an effort to improve the state of the practice in Indore.

Levinson, H.S., et al., 2003 An existing mixed flow lane on an arterial represents the most basic form of running way. BRT vehicles can operate with no separation from other vehicle traffic on virtually any arterial street or highway. Increasing levels of segregation beginning with operations in mixed arterial traffic, through exclusive arterial lanes (curbside or median), contra-flow freeway bus lanes, normal-flow freeway HOV lanes, grade-separated lanes or exclusive transit ways on separate rights-of-way and bus tunnels add increasing levels of travel time savings and reliability improvement for the operation of BRT services.

Pucher et al. (2005) describes the public transport reforms in Seoul and assesses their impacts on safety, speed, costs, passenger levels, and overall customer satisfaction.

TCRP A-23 project (2006): stated that, BRT is a flexible, rubber-tired rapid transit mode that combines stations, vehicles, services, running way, and ITS elements into an integrated system with a strong positive image and identity. BRT applications are designed to be

appropriate to the market they serve and their physical surroundings and can be incrementally implemented in a variety of environments.

Zheng and Jiaqing (2007) present the actuality of South-Centre Corridor Bus Rapid Transit line of Beijing in China, and summarize and analyze the application effect from the management condition, service level, and social benefit. After the regular bus lines at Beijing South-Centre Corridor being adjusted stage by stage, the operation environment has been greatly advanced, and the volume as well as speed of vehicles has obviously improved; with the improvement of the service level, the reduction of traveling time of the passenger, the improvement of the satisfaction level, the improvement of the bus speed, the reduction of delay, the improvement of the punctuality rate, the BRT is exactly "the third mode" existing between orbit transit and regular bus transit.

Eboli and Mazzulla (2007) measured customer satisfaction in the context of bus service on various factors including availability of shelter and benches at bus stops, cleanliness, overcrowding, information system, safety, personnel security, helpfulness of personnel, and physical condition of bus stops. TCRP Report 100 identifies the following elements at bus stations for efficient service: shelters, waiting rooms and seating, doorways, stairways, escalators, signage and information displays, public address systems, and passenger amenities.

Aworemi et al. (2008) look at the impact of socioeconomic characteristics of formal and informal public transport demand in Kwara State, Nigeria and suggest that government must totally support the informal and formal public transport sectors (private transport companies) by providing well-articulated policies to improve the performance of operations and services. One necessary condition for the realization of quality and the creation of value added is quality meas.

Federal Transit Administration (2009): BRTS is an innovative, high capacity, lower cost public transit solution that can significantly improve urban mobility. This permanent, integrated system uses buses or specialized vehicles on roadways or dedicated lanes to quickly and efficiently transport passengers to their destinations, while offering the flexibility to meet transit demand. BRT systems can easily be customized to community needs and incorporate state-of-the-art, low-cost technologies that result in more passengers and less congestion.

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

(Hidalgo, 2010) Improvements and quality of service increases ridership of the system. Curitiba RIT is one of the leading BRT operations in the world with 2,26 million passengers per day. Electronic ticketing has been used in RIT since 2002 including contactless cards. Tube stations and mid-point stations provide prepayment facilities. Some buses are operated with on-board ticketing; this operation can be done either via smart cards or paying directly to the conductor. (Hidalgo, 2010)

(Hook et al. 2012) Different measures use different sets of indicators. This is also dependent on its end use and the availability of data types used in evaluation. One should primarily base indicator selection on the end use of bus performance measures. Selection of indicators is often based on the availability of measurable or observable data. A wide gap frequently exists between end use and data availability to assess performance because either relevant data are not observable or is too expensive or difficult to collect (Hook et al. 2012). Thus, developers of performance measures often use proxy indicators. Since many measures use proxy indicators (Hook et al. 2012), because they are cost effective, there efficiency in replacing appropriate direct indicators remain open to evaluation and debates.

(CEPT, 2012) The study done by CEPT University, in which 1040 BRTS users were surveyed. From the study, it is concluded that the BRTS has failed to attract poor & affluent section of the society. Overall, BRTS serves mainly those from the middle income group most of whom are captive public transport users. From the study, it is evident that the major shift of users was from AMTS which is 47%. Only 12% users had actually made switch from private vehicles to BRTS.

(Gandhi 2013) To overcome these deficiencies in performance evaluation of bus based public transport systems, a spreadsheet based modelling tool (S G Architects and Fazio

Engineer ware 2013) has been developed. This tool provides quantitative assessment of bus performance against multiple indicators. These indicators respond to the requirements of three stakeholders in a public transport system. These are the society, passenger and the operator (Agarwal 2011). The tool has two main components. One of these is the modelling engine which predicts performance in terms of commercial speed, passenger speed, capacity, etc. and uses design, planning and context related inputs such as operation type, station type, average trip length etc. The outputs of the modelling engine include prediction of commercial speed, passenger speed, journey time, capacity, etc. Second component is the evaluation framework. Outputs generated by the modelling engine are used as inputs in the evaluation framework (S G Architects and Fazio Engineer ware 2012b).

(Patel & Soni, 2013) BRTS is relatively newly introduced transport model in Ahmedabad. According to the research carried out, the satisfaction level of consumers using BRTS depends on factors such as safety, comfort, time and money. BRTS users were found reasonably satisfied on these parameters. Overall satisfaction level was also found quite high.

(Mahadevia, Joshi, & Datey, 2013) It is commendable that there is 'network' thinking involved in the planning of BRTS and not 'corridor' thinking. With the expansion of the BRTS, the ridership is increasing and the service is becoming increasingly popular amongst the people of the city. Since the system became operational, both ridership and revenue has grown impressively. The system is being seen as a trademark of the city and is also used for marketing the city.

(Rizvi, 2014) The system is enthusiastically supported by the city's residents and provides a genuine and operational transportation alternative for Ahmedabad, with plans underway for continued expansion. Ahmedabad has realized significant safety improvements recording a 28% decline in fatalities and 20% decline in accidents in the first year of BRT operationalization (Jaiswal et al., 2012).

(Inamdar, 2015) In Ahmedabad, the BRTS, Janmarg, has been successful because it was implemented in a non-congested area and people are able to benefit by using public transport.

(Patel & Makwana, 2015) From the study carried out, it is concluded that along with BRTS, most of the customers are using AMTS & personal vehicles as other mode of transportation. People prefer more BRTS than AMTS because of salient features of BRTS like timely availability, comfort, safety, security, announcements.

OBJECTIVES

1. To assess the present status of BRTS Project
2. To carry out the SWOT analysis of the BRTS Indore.

METHODOLOGY

In this Research study descriptive research is being used, the SWOT analysis has been done for the project in detail. This would enable to understand the present position with exploration for new areas of investigation.

TOOLS FOR DATA ANALYSIS:

1. SWOT analysis of BRTS.

ANALYSIS AND FINDINGS

SWOT ANALYSIS

STRENGTH:

- Defined route.
- No hassles: due to Level boarding
- Saves time & Energy
- Environmental Quality
- Efficient operation cost.
- Reduction in accident rate
- Wholistic transformation in urban life

WEAKNESS:

- Space constraints
- Safety Compromised
- Improper planning
- Lack of Technical Knowledge

- Bottle neck due to design Issue
- Low Frequency of buses
- Traffic Signals
- Supporting infrastructure
- Parking facility
- Foot over bridges
- Traffic Discipline
- Drainage problem

OPPORTUNITIES:

- Bus Priorities & Bus Lanes
- Off Bus Fare Collection
- Increased Capacity
- High frequency All

THREATS:

- Road Congestion
- Failure of project

SWOT ANALYSIS (DETAILS)

STRENGTHS

Defined route

The main feature of a BRT system is having dedicated bus lanes which operate separate from all other traffic modes. This allows buses to operate at a very high level of reliability

since only professional drivers are allowed on the defined route of bus. A side benefit of this is lower construction costs since bus ways can be reengineered to tighter standards and still remain safe compared to a roadway open to nonprofessional drivers. However, the biggest benefit of this corridor will turn out to be uninterrupted traffic flow because of the segregated bus lanes in the center of the Road. The real cause of traffic jams is the mix of vehicles being driven on different speeds with different routes to follow with the BRTs provision everything will be systematic and specific space shall be available for all range of vehicles.

No hassles: due to Level boarding:

Many BRT systems also use low floor buses (or high level platforms with high floor buses) to speed up passenger boarding making it convenient and enhance accessibility. It has been observed that it is very difficult for the women, senior citizens and the physically challenged people to board the buses because of their stairs being at certain height, But corridor comes to its rescue in a way that the height of the platform have been matched to that of the floor of the buses, so that passengers from all ranges can travel comfortably. Not only the Boarding and landing will be eased up but also the accidents or the injury ratio will come down drastically. It will increase the speed with which passengers can board and come out so saving the time of both, themselves and the bus as well and it might be able to take one more round on the day on an average term.

Saves Time and Money

Fundamentally BRTS intends to provide better speed than an ordinary bus lane, it is obvious that it will save a lot of time of the commuters. Apart from this as the people reach home early it directly saves there fuel and thereby money. It is assumed that cars takes anything less than half the time taken by the bus to cover the same distance, but in these corridors there would largely remain any difference in time taken to reach same destination. So it will also increase the customer base and the number of person using public transport will be on a roll and thus it would further reduce traffic on the roads and thus bringing further efficiency. It is assumed that four wheelers and two wheelers take half of the time taken by buses to cover the same distance. With the provision of these corridors there would hardly be any difference in time take to reach the same destination and sometimes lesser the time than

what it used to take earlier. It is felt that with this in view the customer base would increase significantly and the person using public transport would augment considerably. It would help out in reducing the traffic on the roads resulting in further efficiency.

Environmental Quality

There would be substantial improvement in the environment becoming hygienic, thus becoming qualitative due to a number of factors. Ridership gains suggest that some former automobile users are using transit as a result of BRT implementation. Since the commuters would be shifted from private to public transport as a result of BRTS implementation, the benefits would be considerably increased. The Transit agencies like AICTSL are serving passengers with fewer hours of operation, potential reducing emissions. Most importantly, AICTSL adopting vehicles with alternative fuels, propulsion systems, and pollutant emissions controls.

Efficient operation Cost

It is evident that there would be a lot of operation cost efficiency and service productivity for transportation. Experienced from other BRTS in other cities. The following corridor performance indicator would provide considerable advantage.

- Passenger per revenue hour
- Subsidy differentiation due to higher kilometer coverage
- Discount to agencies on the basis of kilometer coverage
- Operation per vehicle per hour

Furthermore, travel time savings and higher reliability enables transit agencies to operate more vehicle miles of service from each vehicle hour operated.

Reduction in Accident Rate

This corridor is an answer to killer line or the 'blue line'. The reasons for so many accidents taking place on the roads with the buses was the merging of different sorts of traffics and the crowdedness. But corridors comes to the rescue in a way that now it will be separate lane for the buses and separate for other motor vehicles like bikes, scooters, cars, etc. it is expected that it will lower down the accidental rates dramatically. Now it is also that the provision of corridors would be a perfect answer to killer line. Since verity of vehicles being used the traffic jams, unorganized traffic on the roads is on an increase crowd

at unorganizedness of the vehicles is a common seen on the roads with the corridors which would be coming will improve the overall road scenario. This slow moving vehicles like bicycles, rickshaws, bullock carts, pedestrians can all move in their respective lanes without feeling the threat of those over speeding cars and bulky buses and trucks. They can move on as per their convenience and on their own speed. Also it will not interrupt further traffic and thus would not become the cause of traffic jams thereof. It is obvious that interruption on the road, overtaking, hassles, difficulty in moving of the vehicles would be reduced to a major extent. The accident rate would also be slowed down and will be reduced to great extent.

Wholistic transformation in urban life:

Once these corridors are made in any city, it definitely adds up to its infrastructural values and its level of urbanization. The flaunting of these corridors makes city look descent, disciplined, and stable as well. As the flyovers and underpasses adds up to its credentials, beautification and easiness. The same way BRT corridors do but even at higher rates. The city definitely becomes the talk of the day and also it would be appreciated by the local commuters, national tourists and commuters and finally by international tourists. There is wholistic transformation of the city. It supports the tourism industry as well.

WEAKNESSES

Space constraints:

Indore city is originally disorganized city from the time of Holkers. Whenever, any change due to making it organized on the city always faces space constraints. The construction of BRTS corridor would requires roads to be broader one, requiring removal of encroachment or removal of legally constructed houses, temples, mosques, gurudwaras, etc. Well successful implementation of this corridor, separate lanes have to be constructed for the high capacity buses, for different motor vehicles and also a different lane for slow moving vehicles and the pedestrians as well. It means that a total of 4 lanes are mandatory on each side of the road. Moreover motor vehicle would individually demand two adjacent lanes looking at heavy traffic of this type. Because of this deficiency, traffic jam problem could not arrive at a solution, and rather problem has actually stiffened due to reason that thousands of light motor vehicles travels every hour which needs more pace. So non

performance space management has become its most severe weakness. Most of the roads of INDORE are just 12-15 meter wide, which are half of the requirements. To make shelters also a lot of space will be required which further needs expansion of roads.

Safety Compromised

Safety is the most important issue which can never be compromised yet craters on BRTS corridor pathway are constructed without prior testing of roads. The compatibility of the current roads is not checked to ensure further construction on them, which results in accidents and injuries only and even deaths sometimes. It would be better if this aspect is gone into depth, its nitty-gritty is understood and minimum compromise on safety also is a load, which otherwise cannot be taken care off.

Improper Planning:

Any project of this size and constraints thereof need to help proactive approach and efficient planning. If this corridor would have been planned properly keeping in mind all the parameters affecting it, it might result into a benefit for the city. Planning with respect to how to go about it, in which areas to make it and what should be the components, so that the things happens to be as per the requirements of the city

Lack of technical knowledge:

just by copying the western countries, Corridor has been made in Indore as well, but the reason for its turmoil is the lack of technical knowledge as to how to proceed for these corridors, without going into research work with respect to whether INDORE needs it at the moment. Just copying is not going to benefit, it is also mandatory to know whether it is required or not. Moreover the structures which are created outside India, in countries like America, Europe etc. Are way ahead advanced with latest technologies which are installed in them. Also before creating, they also see to requirements of broadening the road width, which was absent in the case of Indian roads to a large extent.

Bottlenecks due to design Issue:

Delhi BRT System allocates space on an equitable basis for all types of vehicles like motorized vehicles, non-motorized vehicles and buses. However, the introduction of the pilot project led to significant traffic problems, i.e. Mainly congestion and queuing at the junctions in motorized vehicle lane. It has been observed that in the peak hours there are some delays and congestion at some locations that are most notable at PALASIA TO

GEETABHAWAN. However, the problem does extend to other junctions as well. The junction's holding capacity is less when compared to number of vehicles on the corridor. Moreover, the presence of large population of two-wheeler owners further complicates the situation at all junctions. Due to heavy traffic flow, certain features need modification in road curvature, islands at lane exits and bus platform features.

Low Frequency of buses:

FEEDER buses are plying on four key routes, covering the BRT Corridor. Corridor Manager is compiling bus operation data on a daily basis. It has been observed that the frequency of buses is almost half in the evening. The company has made repeated request to AICTSL to introduce more buses on these routes, as buses are very crowded in the evening.

Traffic Signals

Current traffic signals fail to discharge the traffic at peak hour, as traffic flow is not stable and creates a long queue of cars in motorized vehicle lane as well as the bus Lane. Currently, static traffic signal system is installed at BRT corridor, and on many times it is restored to manual operations of the signals. However, the manual control of signals is incompatible with efficient operations. Manual control tends to operate one phase at a time which is inefficient. Manual and automatic systems have conflicting/dangerous signal phases, thus, switching system from automatic to manual and vice-versa can be dangerous. Sometime, long cycle time, i.e. more than 240 seconds cycle and unsaturated phases add to inefficient operation. There is a need to install "Intelligent Transport Signaling System" to automate the whole process.

Supporting Infrastructure

BRT system cannot be developed in isolation. The agency needs to develop the supporting infrastructure to make BRT successful and popular. There is need to develop the supporting infrastructure.

Parking facility

There should be a parking facility at key intersections or interchange points. The parking facility will enable the commuters to park their private vehicles and board bus to

reach their destination. The parking facility has subsequently been built up to ease some of the congestion.

Foot over Bridges:

Most of the people raised question about the pedestrian crossing facility. Experts have observed that at grade pedestrian crossing on BRT Corridor is fine and normal. Moreover, pedestrian facilities at BRT Corridor have set a new high standard for BRT, with tactile tiles facility for visibly-disabled. However, current corridor lies in a high density area, dividing a community. Thus, there is need to build FOBs or subways at certain points to facilitate the crossing.

Traffic Discipline

One of the key requirements of a successful BRT System is lane discipline among the commuters. Lane discipline on BRT requires users to drive in their respective lane only. Damage to structures by errant drivers is also a problem area. Corridor Manager is compiling the daily list of vehicles entering the Bus lane. Further, a large number of vehicles, mainly scooters and motor cycles are entering into the cycle and pedestrian lane. Corridor Manager is not authorized to penalize the vehicles violated the traffic laws and lane discipline. The enforcement power is still vested with STA (state transport authority) and INDORE Traffic Police. Both the agency are already grappling with the shortage of manpower, thus enforcement mechanism is very weak.

Drainage problem:

Although BRTS authorities are claiming they have made adequate arrangements for drainage problem but the factual position is reverse recently when the rains were very high in Indore. There was accumulation of water resulting into flood like situation at various places. The print media and electronic media have lighted this issue along with public endorcement.

OPPORTUNITIES

Bus priority/Bus Lanes

Preferential treatment of buses at intersections can involve the extension of green time or actuation of the green light at signalized intersections upon detection of an approaching

bus. Intersection priority can be particularly helpful when implemented in conjunction with bus lanes or streets, because general purpose traffic does not intervene between buses and traffic. Large green signals would allow passing of traffics quickly.

Off-bus fare collection

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

Increased capacity

Another benefit of this corridor is that now it is possible to run high capacity buses normally called as double Decker. Earlier it was difficult to run these buses because of limitation of space with respect to clear width and height as well, but this BRT corridor takes care of all issues and is created in a way that nothing can stop them, no pole, no wire to interrupt etc.

Serves a diverse market with high-frequency all day service

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

THREATS

Road Congestion:

The biggest threat to the existence of the BRT corridor is the congested roads not in the context of traffic but with respect to width which is not sufficient on most of the roads for segregation. If we segregate the road for the buses and the other vehicles, the problem is that buses would be able to move swiftly but the problem will be for thousands of other vehicles which will have to use area which is less than earlier. The frequency of buses is just 10% of that of other vehicles, so it is totally unfair that both

kinds of vehicles use same space when the difference in their frequencies is almost 8-10 times. However the widening of roads could have been an ideal solution of this problem, but the difficulty in implementing this is that there is not enough space available along both the sides to expand the road width. Availability of service lanes can be helpful, but they are not that wide at every road and even at some points they do not even exist.

Failure of project:

The stretch from **LIG SQUARE TO NAVLAKHA SQUARE** has been a big failure which increases the odds against the corridor. If this corridor would have been an success then there not have been anybody opposing it. But the problems, which came into limelight after its construction, have posed a threat to its future. To evade from this threat, the government will have to consider each and every problem, their causes and the probable solutions so that it comes to the rescue of the INDORE commuters.

CONCLUSION

The current not-so-successful story of BRTS corridor can be explained by lack of proper planning before implementing it. The technical knowhow of the BRTS system from western countries has been just copied over to INDORE without the modification required to make it successful in India. To make the system successful, stress has to be made on the supporting infrastructure. Also, a proper regulatory environment is needed to enforce rules and regulations where needed.

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