Delhi BRT System – Lessons Learnt

1.0 Introduction

Delhi is known as 'city of flyovers' in India. In last decade, a number of flyovers were built to ease the traffic condition on the road. Flyovers and underpasses were built to increase the mobility of the commuters. The new expanded road spaces were seen as a symbol of progress and speed and were accepted with much fanfare. However, each action has many tradeoffs. In order to create private vehicle oriented infrastructure, the public transportation system was neglected. Further with city's buoyant economy, cars have replaced buses on the roads and cyclists have switched to two-wheelers and motorcycles. Pedestrians are now treated as most marginalized commuters on the road. Increased number of vehicles on the road has not only reduced the mobility of large section of people, but has also increased the pollution level, journey time and average per KM fuel consumption.

In 2002, Supreme Court issued an order to convert all diesel buses into CNG. The action aimed to reduce the carbon level in the air and also generated hopes of a clean and healthier society. However, in a time of less than a decade, the gains that accrued from the CNG program have been lost. All the options available under the first generation reforms have been exhausted.

In August 2008, the average total suspended particulate (TSP) level in Delhi was 378 micrograms per cubic meter--approximately five times the World Health Organization's (WHO) annual average standard (Source: Central Pollution Control Board). It is estimated that over 3000 metric tons of air pollutants are emitted in Delhi (MOEF, 2002).

To address all these issues, Government of National Capital Territory of Delhi (GNCTD) envisions an Integrated Multi-Modal Network of Public Transport system consisting of a network Metro, Mono Rail, Light Rail and Bus Rapid Transit (BRT). The overall vision aims to strengthen the public transportation system and envisage a long-term solution to city's traffic and parking problem.

2.0 Traffic Scenario in Delhi

The transportation network in Delhi is predominantly road based with 1,284 km of road per 100 km^2. The number of vehicles on Delhi's road has increased from 19.23 lakh in 1991 to over 60 lakh by 2008, an increase of 212% in last 18 years. Road space in Delhi is 21% of total space available, thus there is little scope of future expansion of road length. The road length in Delhi has increased from 22,487 km in 1991 to 31,183 km in 2008, a modest increase of 17% in the same period. To accommodate the increasing vehicular population, additional space is increasingly sought to be created on either over or beneath the road, i.e. Flyovers and underpasses.

However, traditional approaches do not help to improve the mobility but help to shift the bottleneck from one point to another. For example, GNCTD built more than 15 flyovers on Ring Road to increase the throughput. The condition has improved radically so far as engineering is concerned, but not necessarily in a mobility context. Ring Road has become completely signal-free, but not congestion-free.

Increasing vehicle population is also positively co-related with number of fatalities caused by road accidents, most of these are pedestrians, cyclists and bus travelers. According to recent World Bank report (August 2008), every year road accidents cost India about 3% of its gross domestic product which was more than $1 trillion in 2007. In Delhi alone, 1,128 people lost their life in road accident till July 2008, of which 64 people died in accident by Bluelines buses. Therefore, a long-term solution to improve the traffic condition in Delhi, which include bringing behavioral, attitudinal and cultural changes, is the need of the hour. To avoid the chaos caused by the mixed traffic and mitigate the risk of accidents, there is a need to encourage lane driving of buses that had been introduced earlier with orders of High Court. Further, instead of giving more incentive and road space to private vehicles owners, there is a need to promote public transport.

The success of policy initiatives aimed at public transport is palpable. Delhi Metro has proved to be a tremendous success story in Delhi. The idea was approved in 1998, with an aim to improve the traffic condition and mobility of commuters. Delhi Metro is operating around 90 trains and carrying approx. 8 lakhs passenger per day. The bus system, however, has its own importance. Delhi Metro can not completely replace the Bus-based system on all routes. Due to higher capital cost, low capital return and large gestation period, it is not feasible to build Metro line on all stretches. The logic of this argument is seen from the situation in other cities with well developed metro networks like London and Paris, where buses still cater to a much larger number of passenger trips than metro.

The reason is that the bus system is more flexible compared to other transportation system. There is, thus, a need to strengthen the bus-based system. In Delhi, buses are generally considered unreliable and time consuming, to reach the destination. Thus, there is need to develop a system to give priority and dedicated road space to buses in order to make them reliable and faster. BRT system is part of the Multi Modal Transport Policy of GNCTD, a total of 7 BRT corridors are proposed to be built in the first phase.

3.0 Delhi BRT System

BRT means giving right of way to buses and safeguarding cyclists and pedestrians by encouraging lane driving on engineered road spaces along large and wide corridors and link them to metros and other colony roads for easy access. Besides giving priority to buses, the system also provides dedicated lanes for pedestrian and Non-motorized vehicles like cycles and rickshaws etc.

3.1 Introduction

The corner stone for the introduction of BRT system in Delhi was put up in 1995, when Central Pollution Control Board commissioned a Study for reducing vehicular pollution in Delhi. The final report, with a recommendation to introduce segregated bicycle lanes and bus lanes, was submitted in 1997. An international workshop was organized by the Delhi Transport Corporation in collaboration with SIAM, IDFC and IIT Delhi on High Capacity Bus System in January 2002. This was the first major step in the conceptualization of the BRT System for Delhi.

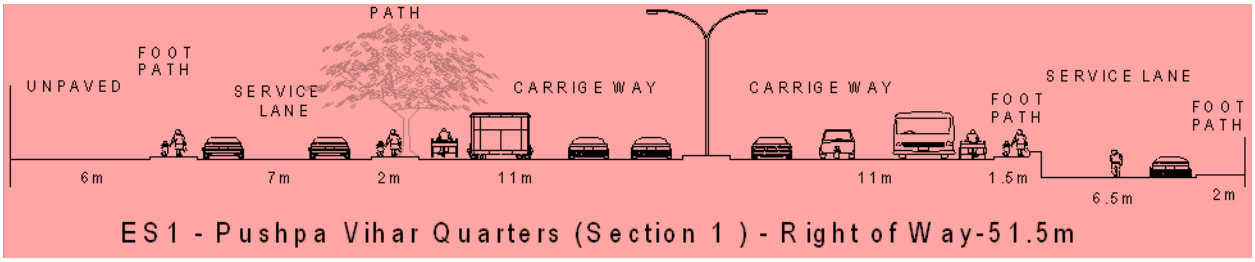
In 2004, GNCTD appointed RITES and Indian Institute of Technology Delhi (IIT Delhi) for designing and implementing the first corridor from Dr. Ambedkar Nagar to Delhi Gate. RITES was appointed the Project Management Consultant and TRIPP IIT, Delhi the technical and conceptual advisor. In 2006, GNTCD established Delhi Integrated Multi-Modal Transit System (DIMTS), a Special Purpose Vehicle to oversee the establishment of public transport systems in Delhi. DIMTS is currently entrusted with the operation and maintenance of the existing corridor as the Corridor Manager.

In October 2006, the construction work on the corridor started. The stretch from Dr. Ambedkar Nagar to Moolchand has been under trial run since April 20, 2008.

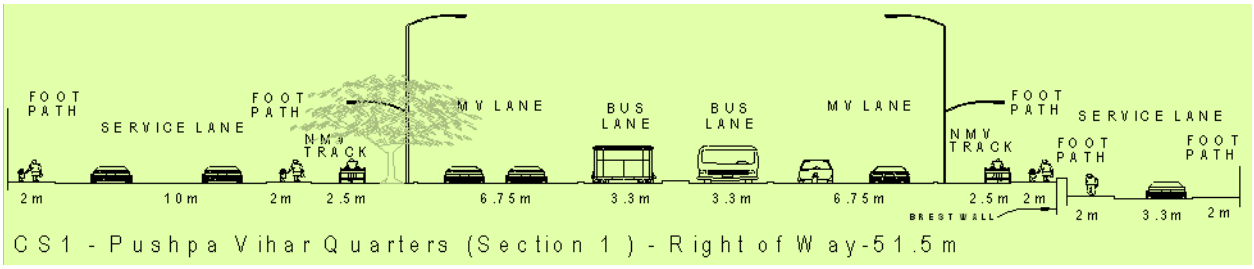
3.2 Technical Details

The first corridor of BRT in Delhi, from Ambedkar Nagar to Delhi Gate, is 14.5 km long with ROW varying from 28 meters to 51.5 meters. Bus Lane is in the middle of Road with a width of 3.3 meters. Motorized vehicle lane is on the side of bus lane with a width of 6.75 meters. Separate tracks are made for non-motorized vehicles and pedestrians.

Pic 1: Before BRT – Cross section



Pic 2: After BRT – Cross section



3.3 Operation Management

Corridor Manager is looking after the operations and maintenance of the BRT Corridor. The scope of work includes all types of operational aspects including traffic management, bus operation, public relations, enforcement, recovery of disabled vehicles, cleaning etc.

Corridor Manager has an internal dedicated team of senior officers to manage the operation on day to day basis. The company has also established an Operational Control Centre (OCC) at Kashmere Gate and one camp office at DTC Khan Pur Depot to monitor the daily progress. Regular monitoring schedules to track operational details are put in place.

Pic 3: Marshal Training

The company has also engaged different third-party service providers to meet specific requirements. As on date, 180 road marshals are deployed on the corridor in two shifts. Road Marshals guide bus passengers, help children and old age people to cross the road, manage traffic, instruct people to follow traffic rules and perform other corridor management activities.

Corridor Manager had also organized a two-day training session with Traffic Police and one-day training session with The Institute of Driving Training & Research (IDTR). This was designed to familiarize the marshals with their assignment at the time of deployment. The company also organized follow-up training sessions for marshals.

Pic 4: Recovery Vans

The company has also deployed security guards at the Bus platforms on 24 hrs basis. Corridor Manager has also hired one crane to remove disabled vehicles from the corridor. Since April 2008, on an average 3 vehicles break down on the corridor each day and all disabled vehicles including buses are removed in about 10 minutes response time.

Corridor Manager also organized special three-days training sessions at IDTR for both DTC and Private Stage Carriage drivers. It also organized one-day training sessions for other drivers like school bus drivers etc. Over 700 drivers were trained and stipend was paid to all blue line and contract carriage bus drivers to ensure attendance.

Pic 5: Literature

An introduction of new system requires a change in behavioral pattern of the users. To address this issue, Corridor Manager designed and printed brochures for all types of commuters, traffic Signages booklets for drivers and a list of do's and don'ts for general public. Wide distribution of this literature was ensured. Further, Bus queue shelter (BQS) advertising space was used to educate people.

Corridor Manager also took an initiative to involve school authorities and children to create awareness about the importance of public transportation system in Delhi. The company communicated with more than 50 school authorities to address their concerns. The company also conducted interactive sessions & made presentations in schools on the BRT system and its key advantages.

Pic 6: Presentation

Pic 7: PIS Boards

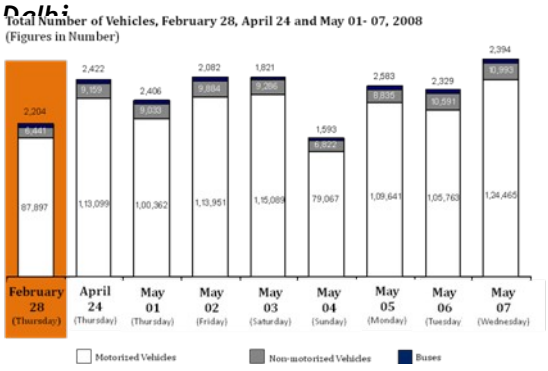
The company has also installed PIS (Passenger Information System) boards on all the 58 BQS. Currently, GPS (Global Positioning System) is installed in new low-floor buses on four routes – 419, 423, 521 and 522. The boards help to reduce the waiting anxiety of passengers waiting at the BQS.

Cleaning and landscaping are the key prime issue for the Corridor Manager. The company ensures that all lanes, BQS and signage are cleaned on a daily basis. State of art mechanized cleaning equipment is deployed for the purpose.

3.4 Traffic Volume

Traffic volume on the BRT corridor is very high. The corridor is situated along some of the prime colonies in South Delhi and is the main connecting road to the large commercial development in Gurgaon. On the stretch from Dr. Ambedkar Nagar to Moolchand, there are 6 key intersections, of which Chirag Delhi and Moolchand are the busiest ones. According to a DIMTS Survey, Chirag Delhi is one of the busiest junctions in Delhi.

Chart 1: Vehicles Crossing - Chirag Delhi



More than 1.35 lakhs vehicles cross the junction in a day (16 hours). Motorised vehicles consisting of cars, two wheelers and auto rickshaws constitute more than 90% of vehicle traffic, of which number of car/Jeep constitute around 35-40% of total motorized vehicles. These, however, carry only 15-20% of the total commuters. On the other hand, buses account only for 2.0-2.5% of total vehicles, but carry around 55-60% of the total commuters, thus using road space more democratically.

Approximately 200-250 buses move on Chirag Delhi Junction (the busiest section) during peak hour, catering to passenger load of about 11,000 - 12,000 on an average day. It has been observed that net throughput of all kinds of vehicles have significantly improved after the implementation of the BRT and the Bus and cycle transit time through the corridor has reduced.

3.5 Socio Economic Profile of the commuters

According to a DIMTS commissioned socio-economic survey at the BRT Corridor, it was observed that more than 60% of commuters use BRT Corridor mainly for work. Most of the respondents showed their discontent with the existing public transportation system. Respondents preferred to use their private vehicles due to inflexibility and unreliability of the bus system.

Regarding perceptions about a good bus system, more than 50% of respondents suggested ‘timeliness of bus service’, ‘clean bus and well behaved staff’ and ‘certainty of bus service’. The research agency also enquired about the willingness of respondents to use BRT System. Interestingly, 85% of respondents, who are currently not using public transport system, showed their willingness to use new BRT system if it is good.

The study clearly predicts that commuters are willing to shift to public transport system, if the service delivery is improved and responds to their requirements and expectations.

4.0 Problem with the current system

During the trial run, several technical and operational difficulties such as malfunctioning signaling systems, undisciplined private vehicular traffic, jaywalking pedestrians etc. emerged. Corridor Manager also appointed one external consultant to provide guidance in the area of intelligent signaling system in August 2008 and is in the process of improving the signaling system in accordance with their advice.

The current issues and challenges in the context of BRT operation are as follows:

4.1 Design Issues

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 Chirag Delhi. However, the problem does extend to other junctions as well to some extent.

The junction's holding capacity is less when compared to number of vehicles on the corridor. Moreover, the presence of large population of two-wheelers 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.

4.2 Bus Operation

Low Frequency: DTC 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 DTC to introduce more buses on these routes, as buses are very crowded in the evening.

Untrained Drivers: The bus operation is very inefficient. CORRIDOR MANAGER has trained more than 200 DTC drivers to drive buses with a view to ensure the greater discipline in Bus Lane. However, in DTC, buses, route numbers are not matched with Drivers on a stable basis, i.e. drivers are frequently changed on different routes. As a result, it has been observed that very often many un-trained drivers are driving buses in the corridor.

Slow Speed: Currently, all types of buses are allowed to use the Bus lane, including many deteriorated buses and RTVs, which cause frequent breakdowns. Only newer buses meeting quality and maintenance standards should be allowed. It is also found that blue line buses sometimes linger at the bus stops. As a result, sometimes passengers board and alight before the bus platform.

Table 1: Comparison of Bus Speed and Ridership

Line	Speed KPH	Ridership (passengers / hour / direction)
Bogotá TransMilenio	29	42,000
São Paulo 9 de julho	12	34,910
Porto Alegre Assis Brasil	18	28,000
Belo Horizonte Cristiano	15	21,100

Machado		
Delhi	13	12,000
Curitiba Eixo Sul	21	10,640
Mexico City Metrobus	21	8500
Quito EcoVia	18	10,200
TransJakarta	18	4500
Beijing	15	7500

(Source: "Bus Rapid Transit: How Delhi Compares, Walter Hook, ITDP)

4.3 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.

4.4 Supporting Infrastructure

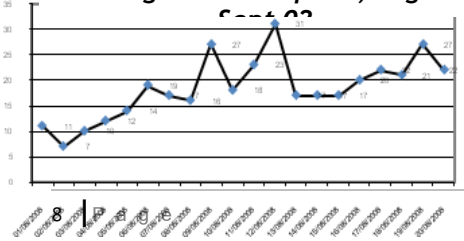
BRT system cannot be developed in isolation. The agency needs to develop the supporting infrastructure to make BRT successful and popular. There is need to develop the supporting infrastructure like:

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 upto ease some of the congestion.

Foot over Bridges (FOB) / Subway: 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. Currently, jaywalking is emerged as the most critical issue for the Corridor Manager. Since April 2008, five fatal road accidents have occurred at the corridor. Jaywalking can be identified as one of common factor for these accidents.

4.5 Traffic Discipline

Chart 2: Number of vehicle Violating Lane discipline, Aug 01 Sept 08



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 Delhi Traffic Police. Both the agency are already grappling with the shortage of manpower, thus enforcement mechanism is very weak.

4.6 Damage to structures

BRT infrastructure mainly BQS, railing, barriers, traffic signal poles, street lights etc. are prone to accident. A large number of accidents were reported in last five months, resulting in damage to property by errant drivers. In the absence of any stringent laws, the cost of rebuilding or reinstalling the street furniture needs to be borne by GNCTD and the operating agency and expenses on this account keep mounting.

5.0 Lesson learnt

The current BRT stretch is labeled as Pilot-A project where the buses are plying in the middle of the road. The government has decided to put buses back on the left lane on the remaining stretch from Moolchand to Delhi Gate and would be labeled as Pilot-B. Both the system (Pilot-A and Pilot-B) will be mutually compared to decide the suitable model for Delhi roads. Thus, the central or side lane is the real controversy behind Delhi BRT System. There are many lessons that need to be learnt from the existing BRT Corridor. These lessons will not help to improve the future corridors but will also increase its acceptability among different stakeholders – public, media, commuters etc.

The agency involved in building the future BRT System needs to look after the following key issues:

5.1 BRT Regulation Act

Before introducing the next BRT corridor, the agency should enact a special regulation Act. The act may help to address some key issues like traffic violation, property damage, jaywalking etc.

In the absence of any regulation, coordination among different agency becomes difficult. Regulation can infer enforcement power to the operating agency on the BRT Corridor, enabling them to ensure strict lane discipline. Secondly, any vehicle causing damage to the road inventory can be easily penalized under the act. Most of the other countries have enacted a separate BRT Regulation Act for smooth functioning of the corridor.

5.2 Park and ride facility

There should be a complete plan for ‘park and ride facility’, ensuring parking facility at key interchange points. Parking facility can compensate the feeder services, enabling people to use their private vehicles till the corridor.

There is also a need to design a BRT friendly 'Parking policy'. Currently, the existing BRT corridor is declared as no parking zone barring private vehicle owners to park their vehicles along the corridor. This gives rise to a need to make provision for parking at certain places near the market, business unit etc. abutting the corridor. Thus, the operating agency needs to make provision for parking facility and integrate the same with the BRT corridor.

5.3 Bus operation

BRT is the Bus Rapid Transit system, i.e. one cannot think about BRT corridor without an effective bus operation. In a highly populated city like Delhi, Bus system and BRT system cannot be work in isolation. Thus, high bus frequencies, route rationalization, introduction of comfortable buses etc. are the pre-requisite for any BRT System. Building appropriate infrastructure is only as important as bringing in the correct operating norms. Both are overlapping activities and not sequential.

The existing BRT Corridor is facing these challenges. On one hand, the system is promoting the use of buses, whereas on the other hand, there are less number of buses on the corridor during the evening. Bluelines buses were removed from the corridor due to their indiscipline whereas DTC is dealing with the issue of shortage of drivers.

5.4 Junction Capacity and intelligent traffic signals

BRT corridor throughput is as good as its junction capacity. It is therefore important that the junction capacity is higher and slip roads are created to facilitate the left-turning traffic. Slip roads will help to reduce the junction load. It is not possible to make motorized vehicle lane completely free for all the turning movement as across the world, BRT system aims to give free way to buses and not motorized vehicles. In Delhi, with limited right of way (ROW) available on the road, it is not possible to provide completely free movement in the motorized vehicle lane. The agency needs to focus on easy free movement rather than complete free movement.

The agency should install an intelligent traffic signaling system with vehicle tracking facility. On the existing BRT corridor, it has been observed that there is no set traffic pattern and traffic movement is very unpredictable. The static system of traffic light, therefore, cannot sense the change in traffic pattern resulting in slow throughput and unutilized green time. An intelligent traffic system will not only synchronize the traffic signals on the corridor, but also on connecting routes to the corridor.

5.5 Restrict left or right movement of the traffic

BRT system aims to give priority to buses. A successful BRT system requires some special measures like restricting the right movement of the traffic on junctions. The TransMilenio, which is known as the world's best bus rapid transit system, restricts the left turns (right turn in Indian context) movement for other vehicles on the BRT Corridor.

The existing BRT Corridor aims to accommodate and fulfill the requirement of every type of commuters. Delhi BRT system is working with maximum number of signal phase for both three and four arm junction. For example, there are six signal phase at Chirag Delhi Junction (i.e.

separate phase for each arm along with bus lane). According to ITDP guidelines, there should not be more than four signal phase in the BRT corridor.

The agency therefore needs to prepare a plan to reduce the number of signal phases in the future corridors, by restricting the left or right movement of the traffic for the future corridor.

5.6 Awareness and education campaign

A new system can be successful only if the acceptability is high among its user. The agency needs to design an appropriate awareness and education campaign to disseminate the relevant information to the public. Dissemination of information however does not mean one way communication, it advocates mutual and interactive communication forums to be setup. Corridor Manager has made efforts to do the same with the public through familiarization meets, open discussion, blogs, one-to-one queries, and presentations at different places including schools, consultation with RWAs etc. For future corridors the agency needs to start the awareness campaigns three to four months in advance.

The campaigns need to aim at involving the younger generation. In the last ten months, negative media campaign has converted even the non-users of the existing BRT stretch into anti-BRT protestors. During presentation sessions at different places, it is observed that people are against the BRT Corridor because they don't have any information about the system. They learnt everything from the media. During the last school presentation at Amity International School on September 02, 2008, it was found that children are very sensible towards the environment and can be champions of environment friendly system like the BRT.

5.7 Connecting FOBs and Subways with BQS

The agency needs to look for the possibility to connect FOBs or Subways directly with the BQS, thus causing little disturbance to the moving traffic in other lanes. Pedestrians movement to or from BQS is the heart of the middle or side bus lane controversy. The agency needs to preplan for additional FOBs and Subways along the corridor to meet current as well as future demand.

There are many more lessons which can be drawn from the existing pilot stretch from Dr. Ambedkar Nagar to Moolchand. The success of the BRT System mainly depends on the willingness to introduce the system, as well as, managing the behavioral changes including the commuting patterns.