Evaluation of Lahore Bus Rapid Transit System

Author’s Details: (1) KASHIF RATHORE (2) KASHIF ALI
Institute of Administrative Sciences, University of the Punjab, Lahore, Pakistan
Corresponding author: KASHIF ALI

ABSTRACT
This study evaluates Lahore bus rapid transit system according to BRT standard 2014. This study concludes that deviation from proposed transport policies is one of the factors that lead towards the failure of urban transport system in Lahore. Government did not pay proper attention to the recommendations proposed in different transport studies conducted by JICA and other transport institutions. The Lahore BRT has failed to receive gold, silver or bronze standard as it only achieved “Basic BRT” status. Lahore BRT is experiencing severe maintenance and operational issues that may lead towards the failure of Lahore BRT system in terms of passengers discomfort and reliability of the system may get affected in future.

Key Words: Lahore BRT evaluation, BRT scoring, performance evaluation, bus rapid transit system, gap between standard and actual Lahore BRT.

1 INTRODUCTION
Lahore is capital of Punjab province with population of 9.25 million according to Punjab development statistics 2014. The increased population needs more educational institutions, health facilities, and employment opportunities. To access these facilities an efficient, safe and comfortable urban transport system is vital. For poor public transport is often the only means of transportation. Without public transport, people would not be able to consider work opportunities at a far distance from their homes. So work opportunities would be limited for them. An effective public transport also improves access to education, health care and recreational facilities. Public transport is also the main means of mobility for the disable, children and senior citizens. In terms of energy consumption and road space used up public transport is more efficient than personal vehicles from urban perspective. Public transport facilitates the people but road traffic accidents also cause injuries and death. According to world health organization, 1.2 million people lost their life and 50 million people got injured in road accidents worldwide (WHO, 2004). The estimated cost of road accidents is 1%, 1.5% and 2% of GNP in low, middle and high income countries respectively (Soderlund, 1995). This cost is greater than 100 billion in Pakistan (Ahmad, 2008). Road traffic injuries ratio is 15 per1000 persons per year in Pakistan (Ghaffar et al., 2004). It is predicted that in 2020, the second main factor of disability will be road accidents in developing countries (Murray, 1997). 10% of all the road accidents are due to road conditions and 15% of all traffic problems are the result of mechanical deficiencies (Aaron 1990; Collier 1983; McGlade 1980). The major reasons for accidents in Pakistan are the lack of awareness about rules and regulations, overloading of vehicles, frequent use of mobile phones while driving on roads and many drivers are addicted of drugs (Abdul Manan et al., 2012). TEPA conducted a study report led in 2008, stated that around 60% of the roads don’t have road safety devices which are a significant reason for road accidents, violation of the traffic rules and traffic jams in Lahore. This study also stated the traffic volume on all city roads of Lahore has crossed the worldwide standard limit of roads that was 8,000 vehicles for every road. The figure 1 represents the road accidents and casualties in Lahore.

![Accidents/casualties in Lahore](http://www.ijmsbr.com)

Figure 1: Road accidents and casualties in Lahore, Source: Punjab Development Statistics 2014

2 STUDY BACKGROUND
The “Master Plan for Greater Lahore” was designed in 1966. This plan considered Lahore a metropolitan area of radius 20-25 km and proposed several towns within the boundary of this radius. But the plan failed to achieve its planned objectives and the city continued to grow without the planned strategy (JICA, 2012). Halcrow Fox UK conducted “Lahore Urban Development and Traffic study, 1980” in order to plan the growth of the city and to plan and integrate the transport development and infrastructure. The main focus was on building new roads instead of addressing the overall growing needs of urban transport which is often the only means of mobility for poor (JICA, 2012). JICA consultants conducted a study report on Lahore transport issues in 1991 with TEPA and LDA. This transport study proposed several development projects in order to improve the transport situation in Lahore. Lahore ring road and some other roads were designed according to the proposed plan. This study also
proposed a light rail transit (LRT) system on Ferozepur road Lahore but LRT system was not designed due to financial constraints although in 1994, Pre-FS was conducted by WB. Study proposed multi-model interchanges of LRT and segregation of non-motorized and motorized traffic in Lahore (JICA, 2012). National Engineering Services Pakistan (NESPAK) conducted a study “Integrated Master Plan” for Lahore to address transport issues in 2001. This study proposed a transport plan for 2020 regarding urban transport. However the study does not address relationship of travel demand and urban development (JICA, 2012). Planning Commission, Government of Pakistan proposed a strategic vision of 2030 regarding transport policies in August 2007. The 2030 vision stated that the current road infrastructure is insufficient in order to capture new investment in industry and in agriculture services. Lahore has inefficient and insufficient traffic management system with fewer than 150 traffic lights which resulted in traffic congestions (JICA, 2012). In order to provide mass transit facilities to the citizens two rails based mass transit lanes of “Green and Orang lines” was also proposed. The feasibility study of green line (from Shahdara to Hamza town on Ferozpur road) conducted in 2006 and reference design for this system was completed by SYSTRA in 2008 and this was likely to be completed with a cost of USD 2.4 billion in 2015. The feasibility study of orange line was done in August 2007. No further work is done on this project after June 2008 (JICA, 2012). Lahore Urban Transport Master Plan 2012 (LUMP) stated that an efficient urban transport system is the only way to meet the transport demand in Lahore. The Lahore transport network would be composed of light rail mass transit system (LRMTS) and bus rapid transit system (BRTS) with a comprehensive network of feeder routes operated by vehicles of different types. The current urban transport network infrastructure with a population growth rate of 2% with 6% growth rate of GRDP will not be able to sustain future transport demand in Lahore (JICA, 2012). LUMP 2012 proposed one RMTRS with seven BRT lines for the period of 2012-2020 and later 2 BRT lines (Orange & Blue) will be upgraded to light rail mass transit system (LRMTS) in 2030 (JICA, 2012). The following table 1 represents the proposed RMTRS and BRT lines in Lahore.

**Table 1: RMTRS and BRT Lines Proposed for 2020 and 2030**

<table>
<thead>
<tr>
<th>Project Code</th>
<th>Project Description</th>
<th>System</th>
<th>Daily Boarding</th>
<th>Max Line Load (Pax Per Hr Per Direction-PPHP)D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>2020</td>
<td>2030</td>
</tr>
<tr>
<td>PT06</td>
<td>RMTRS Green Line</td>
<td>RMTRS</td>
<td>759,000</td>
<td>980,000</td>
</tr>
<tr>
<td>PT07</td>
<td>RMTRS Orange Line</td>
<td>2020 BRT/ 2030 RMTRS</td>
<td>510,000</td>
<td>743,000</td>
</tr>
<tr>
<td>PT08</td>
<td>RMTRS Blue Line</td>
<td>2020 BRT/ 2030 RMTRS</td>
<td>270,000</td>
<td>379,000</td>
</tr>
<tr>
<td>PT09</td>
<td>BRT Purple Line</td>
<td>BRT</td>
<td>129,000</td>
<td>276,000</td>
</tr>
<tr>
<td>PT10</td>
<td>BRT Line 1 (Red)</td>
<td>BRT</td>
<td>88,000</td>
<td>285,000</td>
</tr>
<tr>
<td>PT11</td>
<td>BRT Line 2 (Light Blue)</td>
<td>BRT</td>
<td>109,000</td>
<td>331,000</td>
</tr>
<tr>
<td>PT12</td>
<td>BRT Line 3a (Pink)</td>
<td>BRT</td>
<td>161,000</td>
<td>265,000</td>
</tr>
<tr>
<td>PT13</td>
<td>BRT Line 3ab(Pink)</td>
<td>BRT</td>
<td>167,000</td>
<td>248,000</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td></td>
<td>2,193,000</td>
<td>3,507,000</td>
</tr>
</tbody>
</table>

**Source:** Lahore Urban Transport Master Plan, 2012

### 2.1 Lahore BRT

Lahore BRT started its operations on 10th February 2013 in Lahore with an objective to provide safe, efficient and comfortable journey. Lahore BRT consists of twenty-seven stations. Lahore BRT operates in a dedicated corridor especially designed for metro bus service in the middle of Ferozepur road Lahore ranges from Gajumatta to Shahdara. The fleet of Lahore BRT contains sixty-four articulated buses. The seating capacity of each bus is 38 passengers while the total capacity of the bus is to carry 160 passengers. The total travel time from Gajumatta to Shahdara is 63 minutes. The length of the Lahore BRT is 26.1 km which includes 8.3 km elevated section. Punjab Mass Transit Authority (PMA) is responsible for construction, maintenance and operation of mass transit system in Punjab.

http://www.ijmsbr.com
3 METHODOLOGY

Lahore BRT system is evaluated according to the “BRT Standard 2014”. The BRT standard aims to establish a world accepted definition of BRT in the transport industry by the world leaders. BRT insures comfortable travelling experience to passengers along with economic benefits and positive impact on environment (ITDP, 2014). BRT standard 2014 is a tool to evaluate BRT based on international best practices. The BRT standard focuses on the designed characteristics of the system which insure greater performance. This approach is effective for evaluating BRT corridors due to two main reasons; 1) BRT standard is designed to evaluate both planned and built corridor whereas the performance measures only evaluate the existing corridors and 2) It is very difficult to get real data of passengers from start-to-end point to evaluate BRT and its impact on passenger’s travel. In order to evaluate Lahore BRT data is collected through non-reactive as well as participant observation in overall operation of metro bus service. Google maps are used to calculate the total length of the Lahore BRT corridor, distance of stations from intersections and area of Ravi Bridge. In order to explain the difference between desired level of service (BRT standard 2014) and the actual designed system of Lahore BRT, semi structured interviews are carried out. Interviews are conducted with key in-formatives of National Engineering Services Pakistan (NESPAK), Traffic warden and Platform Turizm. NESPAK designed Lahore BRT system and platform Turizm is responsible for carrying operation and maintenance of Lahore metro bus service. Traffic wardens control traffic at intersections and rescue metro bus service if metro bus stuck in congestions at Ravi Bridge or intersections.

4 DATA ANALYSIS

4.1 BRT Basics

BRT basics define the minimum criteria for a BRT system. If a system fails to meet the requirements of a basic BRT then proposed system is not a BRT system. The BRT basics include dedicated right of way; busway alignment; off-board fare collection; intersections treatment and platform level boarding. A proposed BRT corridor must achieve minimum 20 points in BRT basics including 4 points in dedicated right of way and 4 points in busway alignment. Lahore BRT achieved 33/38 points in BRT basics. The detailed analysis of BRT basics is given below.

4.1.1 Dedicated right of way

Dedicated right of way helps to achieve higher bus speed and prevents collisions with other public vehicles. Lahore BRT has 24.9 km dedicated corridor with physical segregation and 1.2 km is open for mix traffic at Ravi Bridge between Shahdara and Niazi station. Intersections are not turns prohibited. Congestions, traffic jams and breakdown of any vehicle at Ravi Bridge may affect operation of metro bus service because there is no other way to reach Shahdara station. Lahore BRT has 95% dedicated corridor and physical segregation in the form of fence is applied on it. Lahore BRT achieved 8/8 points in dedicated right of way.

“In case of traffic jam at Ravi Bridge or breakdown of public vehicle/metro bus the efficiency of metro bus service is affected badly because there is no other way to reach Shahdara station” (Traffic Signal Officer).

“NESPAK proposed separate RAVI Bridge for Lahore BRT but time constraints and investment was major issue. This project is in pipe line now” (Principal Engineer NESPAK).

4.1.2 Intersection treatment

Intersections may cause to decrease the bus speed and increase the travel time. The delay can be minimized by applying signal priority for an approaching BRT vehicle at intersection but signal priority is only helpful in minimizing delay in low frequency system. Turns prohibited intersections significantly increase the speed of BRT vehicles and reduce the traffic delay. Lahore BRT has four intersections with signal priority but intersections are not turns prohibited which may cause accidents. Lahore BRT achieved 2/7 points in intersection treatment. The data of accidents at Gulab-Devi (Naseerabad) intersection is not available before Lahore BRT operations. The number of accidents has been increased rapidly at this intersection. The number of accidents at Naseerabad intersection from 10th February 2013 to 10th August 2015 is 63 according to PMA. The numbers of accidents of Metro bus with other vehicles are 23 at different intersections. These accidents occur outside the range of metro bus corridor. The design of this intersection demands a pedestrian bridge for passengers to cross the road.

“Near Gulab-Devi intersection there is no pedestrian bridge for people to cross the road. So, people cross the road blindly and collapse with fast approaching public vehicles” (Traffic Signal Officer).

“Metro buses are given signal priority. NESPAK proposed overhead bridges on intersections but time and insufficient funds were a major issue to construct these overhead bridges” (Principal Engineer NESPAK).

4.1.3 Bus-way alignment

Conflict with other traffic can be minimized if BRT corridor is located in the middle of the road way. As public vehicles, taxis and other traffic need to access the curb, so congestion does not occur at the middle of the road. The minimum score should be 4 in order to define a BRT corridor (ITD, 2014). Lahore BRT operates in the middle of the Ferozepur road with two way median aligned bus-way except 1.2 km of Ravi Bridge where metro bus service moves in mix traffic. Lahore BRT achieved 8/8 points in busway alignment.

4.1.4 Off-board fare collection

It reduces travel time and improves passenger’s experience (ITDP, 2014). Lahore BRT has 100% turnstile controlled stations where fare is deducted from tokens or smart card when passengers pass through the turnstile. A BRT will get maximum points if 100% stations are turnstile controlled. Lahore BRT achieved 8/8 points in off board fare collection.
4.1.5 Platform-level boarding
Platform-level boarding ensures the safety of passengers while boarding and alighting at stations. It also reduces the time of alighting and boarding of passengers. The distance between station and bus should be less than 5cm (ITDP, 2014). Platform level boarding allows old people, children and disabled people to board and alight from the bus more easily. Lahore BRT has 100% BRT vehicles that are platform level. Lahore BRT achieved 7/7 points in platform level boarding.

4.2 Service Planning
Service planning is the second criteria to evaluate BRT system. Service planning helps to ensure, whether designed system is able to serve the future demand and efficient enough to overcome the daily problems. It includes multiple routes; express, limited and local services; control center; BRT corridor located in top ten corridors; demand profile; hours of operation and multiple corridor networks. Lahore BRT achieved 9/19 points in service planning. This score indicates that Lahore BRT failed in service planning. The detailed analysis of services planning is given below.

4.2.1 Multiple routes
Door to door travel time can be reduced by reducing transfer time to other vehicles in the presence of multiple routes. Lahore BRT consists of a single corridor which increases the transfer time of passengers. Lahore BRT achieved 0/4 points in multiple routes. Having a single route of BRT is not enough to attract maximum people. All major routes in Lahore are facing transport problems. More funds are required to go with multiple routes network.

“Lahore master plan proposed 5or 6 lanes of BRT. Well it was mainly government’s choice to do so, but there was also an issue of insufficient funds and a need to provide service to the poor immediately” (Principal Engineer NESPAK).

4.2.2 BRT corridor in top ten corridors
A specific portion of passengers will benefit from BRT network if BRT corridor is in top ten corridors in terms of ridership and passengers load then. Lahore BRT is located in top ten corridors in terms of ridership and demand. Lahore BRT achieved 2/2 points as Lahore BRT corridor is located in top ten corridors.

4.2.3 Control center
Control center for real time monitoring of vehicles is essential in BRT system to identify problems and to respond quickly. A Control room helps to monitor the location of vehicles with GPS or other technology. Lahore BRT has full service control room which includes online monitoring of vehicles (VLC), surveillance of stations and intersection with the help of cameras, automatic fare collection system and intelligent transportation system (ITS). Lahore BRT achieved 3/3 points as Lahore BRT has full service control center.

4.2.4 Express, limited and local services
Passengers travel time can be reduced by providing different services like express and limited with local service. Express and limited services help to attract passengers who use car for travelling. Local service of BRT carry passengers from every station while limited service alight and board passengers only from high demand stations. Express service often board passengers from one end of BRT and alight them at other end (ITDP, 2014). Lahore BRT is not operating with limited and express services. Lahore BRT operates with limited service only. As buses are already overcrowded it would be difficult to accommodate new riders and current design of Lahore BRT did not support multiple services. Lahore BRT achieved 0/3 points as it provides only limited service to passengers.

“We don’t need express service on this road as the current BRT lane is serving the transport issues. Other fact is that because we are not operating BRT with multiple routes, so it is not required to launch express and limited services” (Principal Engineer NESPAK).

4.2.5 Demand profile
In order to benefit greater number of passengers it is important to build BRT along highest demand segment of road (ITDP, 2014). Lahore BRT is designed along the highest demand of the road. JICA study “Lahore Urban Transport Master Plan” in 2012 also proposed mass transit system on Ferozepur road Lahore. Lahore BRT achieved 3/3 points in this area.

4.2.6 Hours of operation
A good BRT service should be available for passengers for as many hours as possible otherwise passengers will seek for other mode of service. Lahore BRT service is not available after 10 pm as it operates between 6:15 AM to 10:00 PM in seven days a week. Lahore BRT achieved ½ points because Lahore BRT is not available till midnight but service is available at weekends.

4.2.7 Multi corridor network
Multiple corridor networks provide more travel option to passengers. A BRT system should include multiple corridors that form a network. Lahore BRT operates in a single corridor. Lahore achieved 0/2 points as it is not operating with multi corridor network.

4.3 Infrastructure
Good infrastructure helps to increase passengers comfort during journey and can retain passengers for longer time. Discomfort may result in reduction of ridership. Infrastructure includes passing lanes at stations; minimizing bus emissions; stations set back from intersections; center stations and pavement quality. Lahore BRT achieved 3/14 points in infrastructure. It indicates that concerned authorities totally neglect this area. The detailed analysis of this section is given below.

4.3.1 Passing lanes at station
Passing lanes at stations are important for express and limited services to operate. Without passing lanes it is difficult to start express and limited services and it will be difficult to attract car users with local service of BRT. Lahore BRT does not have passing lanes at stations so it is not possible to start express and limited services of BRT. Lahore BRT achieved 0/4 points because...
Lahore BRT has no passing lanes at stations. In case of breakdown at station the approaching bus at station in same direction will use other lane reserved for opposite direction and if that lane is not free the bus will wait until lane is free to pass. It also increases the chance of collision with other bus coming from opposite direction.

"Due to current station design it is not required to design passing lanes at stations. To have passing lanes at stations, more funds were required at that time" (Principal Engineer NESPAK).

"In some cases it affects the operation. In case of breakdown at station it may take 10 minutes to move the vehicle with the help of lifter or crane and other vehicles have to wait for one minute in case of other lane is not free” (Manager Operations Platform Turizm).

4.3.2 Minimizing bus emissions
It is very important to reduce CO₂ emissions from vehicles to make environment clean. Some fuels as CNG produce lower emissions but it will not assure clean environment if the engine technology is obsolete. So, it is important that certified standard of emissions should be adopted. BRT vehicles must be Euro VI and U.S. 2010 emissions standards. In case of diesel vehicles it is required to use fuel which is compatible with vehicle technology to protect environment (ITDP, 2014). Lahore BRT fleet consists of Euro III diesel vehicles and the available fuel is not compatible for clean environment. BRT vehicles in Lahore are using fuel of Euro II technology. Lahore BRT achieved 0/2 points because BRT vehicles are below Euro IV technology. Concerned authorities need to make better choice for clean environment.

"The current BRT vehicles are also good option. Previously we were not having buses of Euro-III technology. It was the decision of concerned authorities to include Euro III vehicles into Lahore BRT fleet” (Principal Engineer NESPAK).

"It was the decision of the Government to introduce Euro III technology. We can introduce Euro-IV or Euro-V technology and currently we don’t have fuel quality to meet these standards” (Manager Operations Platform Turizm).

4.3.3 Center stations
Centrally designed stations serving both directions of BRT minimize the construction cost and make transfer of passengers more comfortable and easier. Lahore BRT achieved 0/2 points because it does not have centrally designed stations. This design does not allow Lahore BRT to operate with multiple services in the absence of passing lanes at stations. By reduction of passing lanes little bit cost can be saved but more is required to design separate stations. Center station demands passing lanes for smooth operation and more space is required to design passing lanes.

"It involves more construction cost as this design demands passing lanes at stations. As Lahore BRT does not have passing lanes at stations, so it is not required to design center stations” (Principal Engineer NESPAK).

4.3.4 Stations set back from intersections
The minimum distance of stations from intersections should be 26 meters but ideally it should be 40 meters to avoid delays due to congestions at intersection. If the station is designed just near an intersection there is a possibility that other traffic can be delayed due to boarding and alighting of passengers and the risk of conflict remains acute. Lahore BRT has four intersections and more than 75% stations are located at a distance more than 40 meters from intersections. Lahore BRT achieved 3/3 points in this section.

4.3.5 Pavement quality
Good quality pavement helps to deliver comfortable service and reduces the maintenance cost of the road. Roads which are designed with poor pavement quality will remain closed often and speed of vehicles will slow down. Lahore BRT corridor is badly damaged which is certainly decreasing the comfort level of passengers and vehicles life. Lahore BRT achieved 0/2 points in pavement quality. Poor quality corridor decreases comfort level of passengers and buses shut down for maintenance more frequently.

"It was the responsibility of the client and the contractor to insure the pavement quality. Time constraints may be a problem for this issue at the time of construction” (Principal Engineer NESPAK).

"Poor quality corridor increases the maintenance cost and decreases the life of vehicles” (Manager Operations Platform Turizm).

4.4 Station Design
A good designed station increases the comfort level of passengers. It includes distance between stations; safe and comfortable stations; and number of stations on bus; docking bays and sub-stops and sliding doors in BRT stations. Lahore BRT achieved 4/10 points in station design. The detailed analysis of station design is given below.

4.4.1 Distance between stations
Average distance between stations should be 0.3 km to 0.8 km and beyond these distance passengers will walk more time than time saved by higher bus speed (ITDP, 2014). The average distance between stations is 0.97 km of Lahore BRT. It means passengers walk more time than saved by higher bus speed. Lahore BRT achieved 0/2 points as average distance is greater than 0.8 km.

"The distance between stations is ideal as it addresses our local problems. Reducing distance also increase construction cost as it will increase number of stations “ (Principal Engineer NESPAK).

4.4.2 Safe and comfortable stations
A station should be weather protected which means that rain, wind, heat, cold and snow have no effect on passengers standing in a station. The internal width of the stations should be at least 3 meter (ITDP, 2014). Although the Lahore BRT stations are 3 meter wide but stations are not weather protected as stations don’t protect passengers from heat, cold and rain. Although
stations provide shelter to passengers but not enough to protect rain and ceiling fans are installed to save passengers from heat but in severe summer conditions these arrangements don’t protect passengers from rain and heat. The design of the station also doesn’t protect passengers from severe winter conditions. Lahore BRT achieved 0/3 points because stations are not fully weather protected.

4.4.3 Number of doors in bus
Time for boarding and alighting can be minimized with multiple bus doors. Passengers will take more time to board and alight at stations if bus has only one door. In the fleet of Lahore BRT 100% vehicles have four doors which minimize the boarding and alighting time at stations. Lahore BRT achieved maximum points 3/3 as each bus has four doors. Two doors of the bus are reserved for female passengers and last two doors are reserved for male passengers to board and alight into bus.

4.4.4 Docking bays and sub-stops
It not only helps to increase the station capacity but also allow other buses to pass the station. In the presence of multiple docking bays and sub-stops, it is possible to experience different level of services. A station must have two docking bays and one sub-stop at least (ITDP, 2014). Lahore BRT achieved 0/1 point because it only includes multiple docking bays at stations.

“Each station has three docking bays which facilitate multiple buses to dock at each station at same time and MAO station has five docking bays to meet ridership demand. Three bays can be used to dock multiple buses at same time at each station. The existing design of Lahore BRT does not require separate sub stop” (Principal Engineer NESPAK).

4.4.5 Sliding doors at BRT stations
Sliding doors at BRT stations help to increase the safety of passengers and restrict passengers to enter into BRT corridor. Sliding doors also improve the quality of station. Lahore BRT achieved maximum points 1/1 as it has 100% stations with sliding doors.

4.5 Communications
Communications includes branding and passenger information. Lahore BRT achieved 4/5 points in communications. The detailed analysis of communication is given below.

4.5.1 Branding
Branding can play a vital role in public acceptance of BRT services. A good brand of BRT can help to differentiate its services from conventional transport services. A consistent brand image helps passengers to identify BRT system and increase their loyalty by promising superior services. Although Lahore BRT includes vehicles of red color that represents one brand in general but as a whole Lahore BRT doesn’t represent the unique brand identity. Lahore BRT corridor failed to gain unique brand identity. Physical segregation only prevents the corridor of Lahore BRT from other public vehicles. Stations of Lahore BRT indicate different brands as security guards represents different brand while LWMC represents different brand from security guards. Tuck shops at stations show different brand identity from others. Lahore BRT achieved 2/3 points in branding.

“NESPAK was only responsible to design Lahore BRT system. Now it is the jurisdiction of PMA to decide on branding and other issues” (Principal Engineer NESPAK).

4.5.2 Passenger Information
It will be easier for passengers to get information about next bus if real time data is available at stations. This includes electronic devices (audio devices) or LEDs that indicate arrival time of buses on stations. All stations of Lahore BRT have LEDs that give updated information about the arrival of buses. Lahore BRT achieved 2/2 points in passenger information.

4.6 Access and Integration
Access and integration are vital part of a BRT system. It includes universal access; integration with other public transport network; pedestrian access; secure bicycle parking; bicycle lanes and bicycle sharing integration. Lahore BRT achieved 3/14 points in access and integration. The score shows that Lahore proper attention is not paid to integrate the Lahore BRT public transport.

4.6.1 Universal access
All BRT stations should be accessible to all people including disabled and old people. Lahore BRT stations are not accessible to disabled people because stations have ticketing booth on bridges or in underpass that are not accessible by disabled people. Lahore BRT achieved 0/3 points in universal access.

“Normally disabled people on wheel chair don’t prefer to travel in public transport” (Principal Engineer NESPAK).

4.6.2 Integration with Other Public Transport Network
The BRT network should be integrated with other public transport network and the distance between transferring points should be minimum in order to avoid time delay. It also includes fare integration with public transport. Lahore BRT is not integrated with public transport system. Lahore BRT achieved 0/3 points in integration with other public transport.

“It would be the decision of PMA to integrate BRT with public transport, because it is the jurisdiction of PMA and Lahore Transport Company” (Principal Engineer NESPAK).

4.6.3 Pedestrian access
It is important that BRT system should be accessible safely otherwise an efficient and comfortable BRT system is of no use for passengers. All stations of Lahore BRT have safe access for passengers. Most of stations are accessible through pedestrian bridge as Lahore BRT operates in the middle of the road while three stations are accessible through underpass. Lahore BRT achieved 3/3 points in this section.

4.6.4 Secure bicycle parking, bicycle lanes and bicycle sharing integration
Lahore BRT does not support bicycle lanes and bicycle sharing integration. Lahore BRT achieved 0/2 points in secure bicycle parking, 0/2 in bicycle lanes and 0/1 points in bicycle sharing integration.
“In Lahore people are not using bicycles at large. So, there is no need to design bicycle line parallel to BRT corridor. Yet at some stations ride and park facility is available for passengers” (Principal Engineer NESPAK).

4.7 Point Deductions
Penalties are imposed on poor design or management and performance weaknesses. The detailed analysis of point deductions is given below.

4.7.1 Commercial speed
The minimum average commercial speed of Lahore BRT is more than 24 km/h. No point is deducted because average commercial speed is greater than 20km/h.

4.7.2 Minimum peak passengers per hour per direction (pphpd)
Full penalty (i.e.-5 points) should be imposed if minimum ridership in peak hour is below than 1,000 passengers in one direction. No point is deducted because average ridership is greater than 1,000 passengers in peak hour in one direction.

4.7.3 Lack of enforcement of right-of-way
Lahore BRT is physically segregated by means of fence from other traffic. Intersections are protected through surveillance cameras and security guards. Heavy fines are imposed in case of violation. So, no points are deducted.

4.7.4 Significant gap between bus floor & station platform
Full penalty (i.e.-5 points) should be imposed if there is large gap between bus and station platform. Large gap between station and bus make it difficult for massagers to board and alight. This gap may emerge due to poor training of drivers and poorly designed stations. Penalty is not imposed because no significant gap is observed at point of docking at stations during operation in Lahore BRT.

4.7.5 Overcrowding
If overcrowding is observed then full penalty should be imposed (i.e.-5 points). Overcrowding can be observed if average passenger density is more than 5 passengers per square meter, 3 passengers per square meter in more than 25% buses and at stations during peak hour in one direction respectively. If this metric is not easily observable then direct observations can be used for overcrowding. Full penalty is imposed (i.e.-5 points) on Lahore BRT because overcrowding is observed during peak hours in more than 25% buses and at stations.

4.7.6 Poorly maintained busway, buses, stations and technology system
A well designed BRT system can be poorly maintained. A corridor must be penalized if the bus-ways, stations and technology are poorly maintained. Full penalty is imposed (-4 points) on poorly maintained busway of Lahore BRT because corridor is significantly in bad condition which includes potholes. No penalty is imposed on buses, stations and technology system because they are maintained properly.

4.7.7 Low peak frequency
Average headway of buses during peak hour is a good indicator to evaluate BRT service. Each route of BRT should have minimum 8 buses per hour. If planned schedule does not follow this proxy penalty should be imposed. No point is deducted because Lahore BRT fulfills this proxy as each route has more than 8 buses per hour in peak time.

4.7.8 Low off-peak frequency
Average headway of buses during off peak hour is also a good indicator to evaluate BRT service. Each route must have at least 4 buses per hour otherwise penalty should be imposed. No penalty is imposed because Lahore BRT has more than 4 buses per hour in off-peak time on each route.
<table>
<thead>
<tr>
<th>BRT STANDARDS</th>
<th>BRT Standard 2014</th>
<th>Lahore BRT Achieved Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BRT Basics</strong> - Minimum score of 20 points needed</td>
<td>38</td>
<td>33</td>
</tr>
<tr>
<td>Dedicated right-of-way - Minimum 4 points</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Busway alignment - Minimum 4 points</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Off-board fare collection</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Intersection treatments</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Platform-level boarding</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td><strong>Service Planning</strong></td>
<td>19</td>
<td>9</td>
</tr>
<tr>
<td>Multiple routes</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Express, limited, and local services</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Control center</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Located In top ten corridors</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Demand Profile</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Hours of operations</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Multi-corridor network</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td>Passing lanes at stations</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Minimizing bus emissions</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Stations set back from intersections</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Center stations</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Pavement quality</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><strong>Station Design and Station-bus Interface</strong></td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Distances between stations</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Safe and comfortable stations</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Number of doors on bus</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Docking bays and sub-stops</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Sliding doors in BRT stations</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Communications</strong></td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Branding</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Passenger information</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Integration &amp; Access</strong></td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td>Universal access</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Integration with other public transport</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Pedestrian access</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Secure bicycle parking</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Bicycle lanes</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Bicycle-sharing integration</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>100</td>
<td>56</td>
</tr>
<tr>
<td><strong>Point Deductions</strong></td>
<td></td>
<td>-9</td>
</tr>
<tr>
<td>Overcrowding</td>
<td>-5</td>
<td>-5</td>
</tr>
<tr>
<td>Poorly-maintained Busway</td>
<td>-4</td>
<td>-4</td>
</tr>
<tr>
<td><strong>Total Score</strong></td>
<td>100</td>
<td>47</td>
</tr>
<tr>
<td>Lahore BRT Classification</td>
<td></td>
<td>Gold, Silver, Bronze, or Basic BRT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Basic BRT</td>
</tr>
</tbody>
</table>

*Source: The Institute for Transportation and Development Policy: ITDP, 2014*
Gold standard is awarded if a BRT system scores 85-100 points, silver standard is awarded if a BRT system scores 70-84 points and bronze standard is awarded if a BRT system scores 55-69 points. Lahore BRT achieved “Basic BRT” status and failed to achieve gold, silver or bronze standard. It means that Lahore BRT only fulfill the minimum criteria for a BRT system.

![LAHORE BRT VS BRT STABDARD 2014](image)

**Figure 2: Lahore BRT achieved points against BRT standard 2014**

### 4.8 Other Issues

During the field work the following problems have been identified through non-reactive as well as participant observation in overall operation of metro bus service. Besides the fact that Lahore BRT achieved “Basic BRT” status according to BRT standard 2014, it is also important to confirm that whether Lahore BRT actually facilitating the people and the travel time has been reduced. There are two parts of the travel time. The time used to get tokens and the time used to travel in bus. It is important here to note that if passenger has smart card then his travel time will be reduced because time used to get tokens will be saved. Passengers can purchase “SMART CARD” from ticket booth for travelling in metro bus service. This minimizes the delay at ticket booth as passengers don’t need to purchase tokens every time for travel. Long queues have been observed at Shahdara station at ticket booth. Normally passengers have to wait 5-10 minutes to get ticket in peak hours at Shahdara station. This delay in getting ticket increases the total travel time of the passengers. Same situation is observed at canal, Quinchi and Chungi stations. Passengers are not used to TVM machines. So, majority of passengers get tokens from ticket booth. In case of rain, TVM machines at some stations need to shut down because stations are not fully weather protected and turnstiles at some station were out of order due to rain. Delay in getting ticket due to long queues and then delay at Ravi Bridge in mix traffic worsen the traveling experience in metro bus service. BRT corridor is damaged badly which has negative impact on comfort level of passengers.

“Poor quality of corridor has a negative impact on comfort level of passengers and buses got damaged. This also increased the maintenance cost of vehicles” (Manager Operations, Platform Turizm).

Water coolers at stations were run out of water. There was no glass at water coolers to drink water. Paintworks of curb side barrier grill which defines the corridor faced significant rusting within the first year of operations. In addition, generally the paintworks at stations with “high daily ridership” faded away and got rusted within six months of operations. Lahore MBS corridor is severely affected by improper surface drainage at all stations. Water accumulated under the platforms (stations) and escalators which resulted in emergence of mosquitoes and dengue. The drainage system of elevated corridor is damaged badly which has negative impact on comfort level of passengers.

Water coolers at stations were run out of water. There was no glass at water coolers to drink water. Paintworks of curb side barrier grill which defines the corridor faced significant rusting within the first year of operations. In addition, generally the paintworks at stations with “high daily ridership” faded away and got rusted within six months of operations. Lahore MBS corridor is severely affected by improper surface drainage at all stations. Water accumulated under the platforms (stations) and escalators which resulted in emergence of mosquitoes and dengue. The drainage system of elevated corridor is damaged badly which has negative impact on comfort level of passengers.

“The maintenance cost of vehicles increased due to lack of glass at water coolers to drink water. Paintworks of curb side barrier grill which defines the corridor faded away and got rusted within six months of operations. Lahore MBS corridor is severely affected by improper surface drainage at all stations. Water accumulated under the platforms (stations) and escalators which resulted in emergence of mosquitoes and dengue. The drainage system of elevated corridor is damaged badly which has negative impact on comfort level of passengers.” (Manager Operations, Platform Turizm).

Water coolers at stations were run out of water. There was no glass at water coolers to drink water. Paintworks of curb side barrier grill which defines the corridor faced significant rusting within the first year of operations. In addition, generally the paintworks at stations with “high daily ridership” faded away and got rusted within six months of operations. Lahore MBS corridor is severely affected by improper surface drainage at all stations. Water accumulated under the platforms (stations) and escalators which resulted in emergence of mosquitoes and dengue. The drainage system of elevated corridor is damaged badly which has negative impact on comfort level of passengers.

Water coolers at stations were run out of water. There was no glass at water coolers to drink water. Paintworks of curb side barrier grill which defines the corridor faced significant rusting within the first year of operations. In addition, generally the paintworks at stations with “high daily ridership” faded away and got rusted within six months of operations. Lahore MBS corridor is severely affected by improper surface drainage at all stations. Water accumulated under the platforms (stations) and escalators which resulted in emergence of mosquitoes and dengue. The drainage system of elevated corridor is damaged badly which has negative impact on comfort level of passengers.

Water coolers at stations were run out of water. There was no glass at water coolers to drink water. Paintworks of curb side barrier grill which defines the corridor faced significant rusting within the first year of operations. In addition, generally the paintworks at stations with “high daily ridership” faded away and got rusted within six months of operations. Lahore MBS corridor is severely affected by improper surface drainage at all stations. Water accumulated under the platforms (stations) and escalators which resulted in emergence of mosquitoes and dengue. The drainage system of elevated corridor is damaged badly which has negative impact on comfort level of passengers.

Water coolers at stations were run out of water. There was no glass at water coolers to drink water. Paintworks of curb side barrier grill which defines the corridor faced significant rusting within the first year of operations. In addition, generally the paintworks at stations with “high daily ridership” faded away and got rusted within six months of operations. Lahore MBS corridor is severely affected by improper surface drainage at all stations. Water accumulated under the platforms (stations) and escalators which resulted in emergence of mosquitoes and dengue. The drainage system of elevated corridor is damaged badly which has negative impact on comfort level of passengers.

Water coolers at stations were run out of water. There was no glass at water coolers to drink water. Paintworks of curb side barrier grill which defines the corridor faced significant rusting within the first year of operations. In addition, generally the paintworks at stations with “high daily ridership” faded away and got rusted within six months of operations. Lahore MBS corridor is severely affected by improper surface drainage at all stations. Water accumulated under the platforms (stations) and escalators which resulted in emergence of mosquitoes and dengue. The drainage system of elevated corridor is damaged badly which has negative impact on comfort level of passengers.
CONCLUSION

Lahore BRT fulfills the criteria for basic BRT. Lahore BRT has several issues in its design and planning. Deviation from proposed transport policies is one of the factors that lead towards failure of urban transport system in Lahore. The negligence to implement the recommendations of JICA by Government of Punjab and other transport institutions made the transport problem more complex. With the passage of time transport issue has become a challenge for the transport institutions responsible for planning and devising transport strategies. Government of Pakistan requested Japan to conduct a transport study on Pakistan in 2005. After conducting transport study JICA proposed several transport projects in Lahore. JICA also proposed several transport projects in 2012 after receiving a request from Government of the Punjab to conduct transport study in Lahore. JICA proposed rail transit system on Ferozepur road with seven BRT lines on the major roads of Lahore. But Government of the Punjab deviate from the proposed transport projects by JICA and designed Lahore BRT line on Ferozepur road instead of rail transit system. For sustainable urban transport it is necessary to follow the guidelines and policies given by professional institutions of the world. But Government of the Punjab did not pay proper attention to the recommendations of JICA and started Lahore BRT project in 2012 on Ferozepur road instead of rail transit system. Lahore BRT started its operations on 10th February 2013 just before the general elections of Pakistan which was held on 11th May 2013. Poor structure and improper planning indicate that Government of the Punjab completed this project in a hurry. After initiating services (operations) of Lahore BRT four intersections are closed but still problem is not resolved. Accidents at Naseerabad intersection reveal the real picture that problem still exist. The total travel time is increased due to open intersections and Ravi Bridge. This time could be decreased if separate bridge was designed for metro bus service and intersections are not remained open. In the presence of improper planning of Lahore BRT it is difficult to overcome the transport problem in Lahore. Buses and stations are overcrowded indicating that with the passage of the time the current system will become outdated and there will be need to replace the existing system with rail transit system. It is difficult to convert car user into BRT riders in the absence of express and limited service of BRT. There is also a problem that this service is only available on Ferozepur road and other roads are often jam packed. These conditions make it difficult for car user to use BRT services. It is not possible to overcome traffic problem without reducing number of vehicles on roads. As number of vehicles will increase more space will be required on roads for them. If system is not designed to facilitate car users it would be difficult to eliminate traffic issues. The issue will become worst with the passage of time.

An efficient designed system will become obsolete if not maintained properly. If maintenance work is not carried out properly in a result the system will become inefficient. Lahore BRT is facing many maintenance problems regarding BRT corridor, escalators, washrooms, water coolers and sewerage system. Lahore BRT corridor needs maintenance work as corridor is damaged badly at various points. Escalators remain non-operational due to maintenance work. Washrooms are locked due to unavailability of water because electric motor is out of order. Sewerage system is not laid down properly which causes problems for people. Lahore BRT only comprises the set of elements necessary for defining a BRT. Although Lahore BRT has achieved “Basic BRT” status but in long term the current design of Lahore BRT will become obsolete as ridership will increase as forecasted in Lahore “Urban Transport Master Plan 2012” conducted by JICA. In isolation it is not possible to overcome the transport problem as Lahore BRT is not integrated with other public transport network. Delay in maintenance and other issues in operation poses a big question on the capacity and seriousness of “Punjab Mass Transit Authority” responsible for construction, operation and maintenance of mass transit system in Punjab.

REFERENCES