Volume-II – Chapter-3

SUB-SECTOR PLANNING

FINAL REPORT

3 SUB-SECTOR PLANNING

3.1 Road

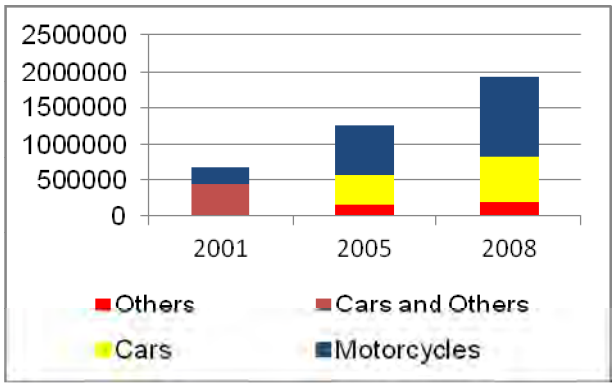
3.1.1 Present Condition of Road Sub-Sector

The overall characteristics of road sector in Lahore are as follows:

1) Motorization

In 2008, 1.95 million motorized vehicles were registered in Lahore. It has become a major transport problem mainly due to rapid motorization. The number of vehicles in Lahore District had increased by 294 % from the one of 2001 to the 2008. The growth is higher than the provincial motorization trend, i.e., 212 % during the same period. Especially, motorcycle had increased by 483 % during the same period.

Figure 3.1.1 Trend in Registered Motorized Vehicles in Lahore District



Source: Punjab Development Statistics

Table 3.1.1 below shows the number of registered vehicles with DRTA, for all districts of Lahore division. Around 1,950,000 vehicles are registered within the Lahore area, to be compared with only 34,000 and 52,000 for Kasur and Sheikhupura. Motorcycles make up for more than half (56 %) of all registered vehicles.

Table 3.1.1 Number of Registered Motor Vehicles ('000) in June 2008

District	Lahore	Kasur	Nankana Sahib	Sheikhupura	Lahore Division Total
Cars, Jeeps and Wagons	638	0	0	4	642
Motorcycles	1,110	6	2	21	1,140
Trucks	16	0	0	1	17
Delivery Vans	40	0	0	0	41
Buses	33	0	0	1	34
Taxis	12	0	0	0	12
Auto-Rickshaws	66	1	0	2	70
Tractors	29	26	0	23	77
Others	1	0	0	0	2
Total	1,945	34	3	52	2,034

Source: Punjab Development Statistics, 2009

Due to such rapid motorization, the number of motorized vehicles per 1,000 residents substantially increased from 95 vehicles in 2001 to 238 vehicles in 2008.

2) Vehicles in the Study Area

Most of Lahore citizen's travel means is dependent on road traffic. The population of the Study Area in 2010 is estimated at about 9.9 million, of which 8.65 million (87 %) are resident in Lahore district. The car ownership is about 350,000 cars, and motorcycle ownership is about 850,000 motorcycles that are 42 % of all households, in total 1.2million vehicles in the Study Area. The classified road vehicles are shown below.

a. Public buses, Large and medium size
b. Mini buses (Delivery Vans), Mini-vans called Wagons
c. Auto Rickshaws, Qingqis (a motorcycle driven Rickshaw)
d. Taxis, and donkey carts

Figure 3.1.2 A Motorcycle Rickshaw - Qingqi

Figure 3.1.3 Donkey Cart

Source: JICA Study Team

3) Urban Road Transport Services

Urban road transport services are mostly based on private transportation. Current conditions are characterized by the dominant presence of motorcycles, increasing number of cars, and decreasing number of bicycles. Public transportation services are provided by Buses (Large/ Medium Size), Mini-vans (Wagon), and Auto Rickshaw. However, their share in urban traffic is low.

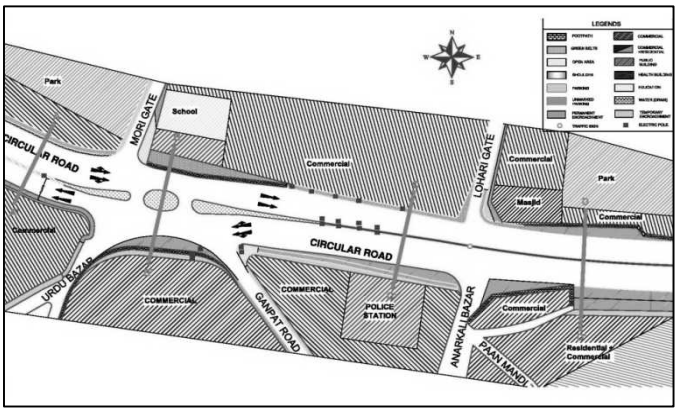
4) Road Intersections/ Junctions

Junctions/ Intersections are very poorly designed and space is not allocated properly to all movements; which results in unnecessary delay for some traffic movements. Street linkages are provided on some of the junction without at any junction priority; this results in cross conflict with main stream movement on junction as shown in Figure 3.1.4. Five streets are directly entering to main flow of traffic; which results in severe traffic congestion and grid locking of traffic in peak periods.

Pre timed traffic signals are installed at 168 (about 64 %) junctions in Lahore out of total 261 with pre-historic timings. Timings for all signalized junctions are same for all time periods which could not accommodate the peak period and special day's traffic flow. All signalized junctions are operating in isolation without any network coordination. There is no provision for safe movement and crossing of pedestrians in midblock locations and at road junctions. Overall, junctions are poorly designed without following safety or geometric design criteria or guidelines.

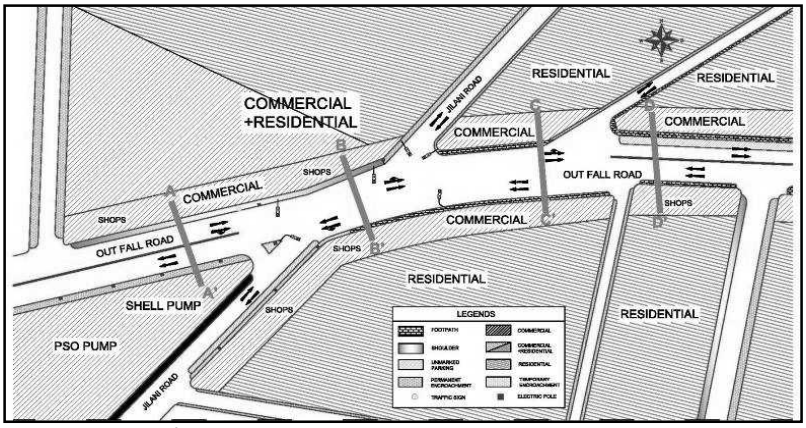
Traffic circulation is provided without any area wide junction study and various (some illegal/ contra-flow) movements are allowed to enter the junction; which creates unexpected and unsafe situation for drivers. Six two way local roads/ streets are entering the junction from all around in Lohari Gate junction as shown in Figure 3.1.4, and poor design of junction on lower bound of Sagging Bridge is shown in Figure 3.1.5.

Figure 3.1.4
Lohari Gate Junction – Poor Junction Design



Source: JICA Study Team

Figure 3.1.5 Corporation Chowk at Exit of Saggian Bridge toward Lower Mall Road – Poor Junction Design

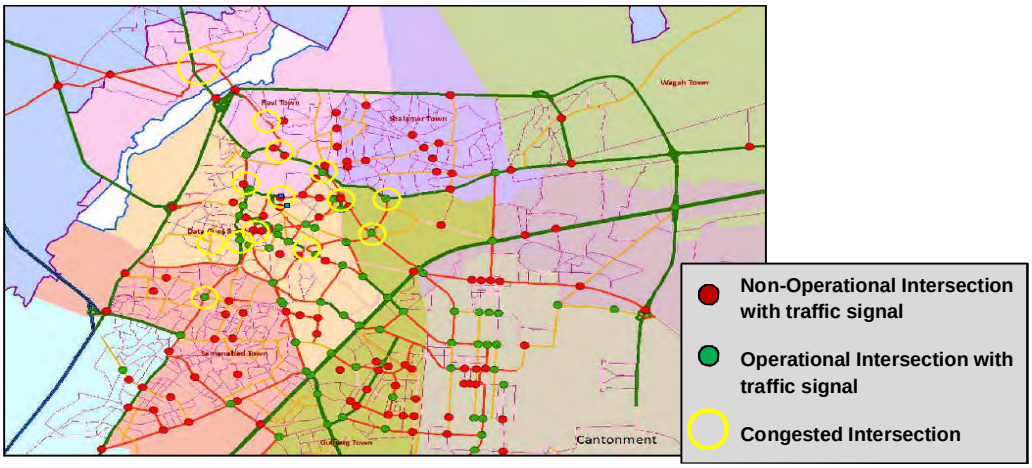


Source: JICA Study Team

Overall the junctions perform poorly and are major traffic bottlenecks especially in old Lahore area between Ravi River and Canal. This is mostly due to poor geometric design,

side friction and commercial activities within the junction area. Some of the junctions identified as major bottlenecks during the survey shown in Figure 3.1.6.

Figure 3.1.6 Location Map of Congested Intersections



Source: JICA Study Team

Areas growth of Canal toward southwest of Lahore are recently developed over last few decades, and are not facing congestion problems. Roads are wide with less side friction due to limited commercial activities along most of the sections except some central shopping areas. Traffic calming is neglected in these areas, and most of the roads are high speed passing through residential areas which would not be sustainable.

The concept of high speed signal free corridors should be changed for the sections of roads passing through communities, commercial and recreational areas etc. Signals need to be connected with network operation for optimization and reduce delays. However most of the commercial activities in these areas are uncontrolled on the same pattern as in old Lahore city. Commercialization is at peak without any traffic or development impact assessment. This is generating unplanned traffic demand for the junctions and results in traffic congestions and creates bottlenecks in peak periods.

5) Traffic Safety

The numbers of traffic accident are increasing, in number of fatalities per year from 100 in 1990 to over 400 by 2007 – see Table 3.1.2. The vulnerable road users are more exposed, traffic fatalities are: 30% pedestrian, 10% cyclist and 8% motorcyclists due to inadequate footpath, cycle path and poor driving manner.

Table 3.1.2 Road Accidents and Casualties, Lahore

Year	Accidents			Casualties		
	Total	Fatal	Non-fatal	Total	Killed	Injured
2005	806	394	412	982	432	550
2007	759	443	316	1,003	455	548

Source: Punjab Development Statistics, 2007 and 2009

6) People's Opinions

The present traffic situation should improve; nearly 90 % people feel it is "Very Bad" or "Bad". Other major reasons; "Increase of Car and Motorcycle Traffic", "Bad Driving Behaviour", "Lack of Enforcement" and "Lack of Public Transport".

7) Road Network

Figure 3.1.7 shows the road network of Lahore in 2010. It was comprised of Motorways, Trunk Roads, provincial roads, and urban roads (including district and other roads) with a total length of about 2,647 km. The Motorways (M-2), G.T. Road, Multan Road (N-5) and Sheikhupura Road are intercity linkages to and from Lahore. Provincial roads connect mainly between urban districts. The urban road network is a radial pattern from the city center (walled city).

8) Present Road Condition

The total road length in LUTMP area is 2,647 km (Motorway = 64 km, Trunk Road = 230 km, Primary Road = 200 km, and urban road = 2000 + km). The density of urban roads in the central area (Walled City) is 3.5 – 5.5 km/km^2. About 85% of roads are paved by asphalt or concrete pavement roads and in rural areas road is either gravel or earth. Lahore has 3 bridges crossing the Ravi River. The right of way in Lahore city is wide and surface condition of most roads is good in general.

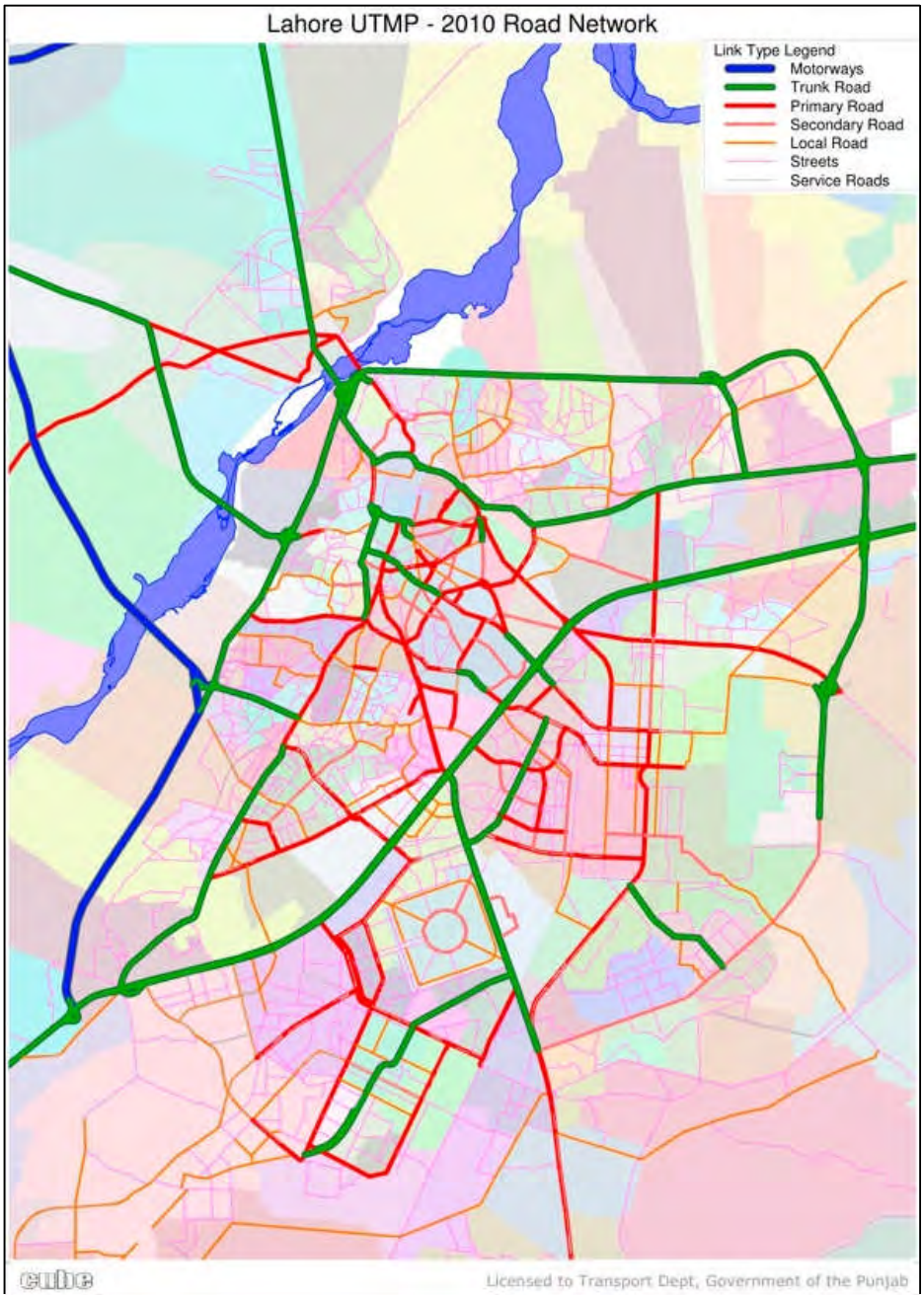
(i) Road Development and Maintenance

Motorway and G.T Roads are developed and managed by National Highway Authority (NHA). However, the management of some sections nearer to the large city is the responsibility of city government. In the case of Lahore, Motorway (M-2), G.T. Road is managed by NHA. TEPA carries out direct management and regular repairs of inner city roads.

(ii) Road Width / Number of Lanes

Figure 3.1.8 shows LUTMP road network by number of lanes. Primary Roads, Motorway and G.T. Road and some major urban roads have four or more lanes with center median and sidewalks (in some areas) except walled city area.

Figure 3.1.7 The Study Area Road Network



Source: JICA Study Team

Table 3.1.3 Road Length and Right of Way

Category	Name/ No.	Section		Length (km)	Right of Way (m)	Carriageway No. of Lanes + Service Road	Remark
		From	To				
Motorway	Motorway (M-2)	Sheikhupura Road	Lahore Ring Road (LRR)	12.2	70-75	6	
		Lahore Ring Road (LRR)	Multan Road	8.8	70-75	6	
Trunk Road	Sheikhupura Road.	Sheikhupura Road	G.T. Road	30.5	65-68	4	
	Saggian Bypass	Sheikhupura Road	Lahore Ring Road (LRR)	6.8	50	4	Ravi Bridge W=20.0m
	G.T. Road	Sheikhupura Road	Ravi Road	4.0	55-60	6+2	Ravi Bridge W=7.0m
		Ravi Road	Allama Iqbal Road	3.7	50	6	
		Allama Iqbal Road	Lahore Ring Road (LRR)	5.5	50	4	
	Lahore Ring Road (LRR)	M-2	Bedian Road	34.6	50-60	6+4	
		Bedian Road	Ferozepur Road	6.8	60	6+4	Under Construction
		Ferozepur Road	Motorway (M-2)	11.9		4+4	
	Canal Bank Road	Multan Road	Ferozepur Road	11.3	120	4	
		Ferozepur Road	Lahore Ring Road (LRR)	12.5	105	6+4	
	Multan Road	Canal Bank Road	Bhai Pheru Road	40.0	29	4	
	Ferozepur Road	Kahna Nau Road	Temple Road	20.0	45-70	4+4	
	Main Boulevard Gulberg	Ferozepur Road	Jail Road	3.8	60	6+4	
Primary Road	Shalamar Link Road	G.T. Road	Zarrar Shaheed Road	3.7	25	6	Flyover W=19.0m
	Walton Road	Ferozepur Road	Aziz Bhatti Road	5.6	65	4+4	
	Jinnah Flyover	Walton Road	Ferozepur Road	4.6	30	4+4	Flyover W=13.0m
	Zarrar Shaheed Road	Lahore Ring Road (LRR)	Canal Bank Road	6.7	30	4	
	Wahdat Road	Canal Bank Road	Multan Road	6.6	24	4	
	Main Boulevard Allama Iqbal Town	Multan Road	Wahdat Road	3.7	35	6+4	

Source: JICA Study Team (Road Inventory Survey)

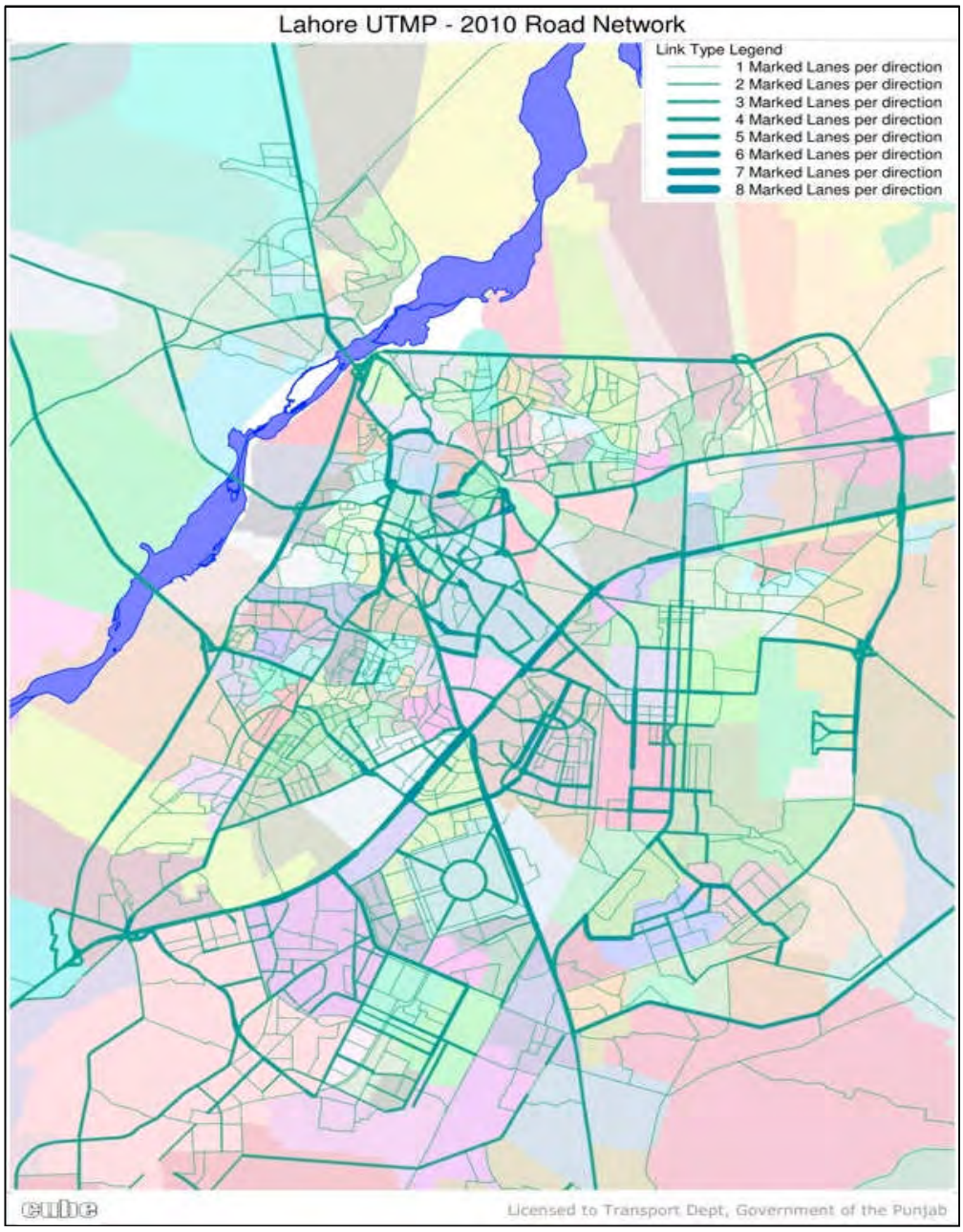
(iii) Condition of Major Roads

a) Motorway (M-2)

The motorway (M-2) is the principal road of Pakistan. It is 367 km length and connects Lahore with Islamabad.

M-2 is passes through the west of Lahore city and it is connects with National Highway No. 5 (N-5) at the Thokar Niaz Baig junction. In Lahore city (LUTMP area) length is about 36km.

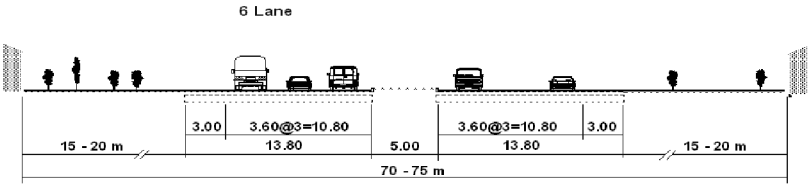
Figure 3.1.8 LUTMP Road Network by Number of Lanes



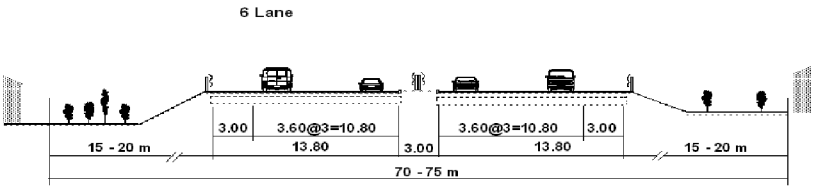
Source: JICA Study Team

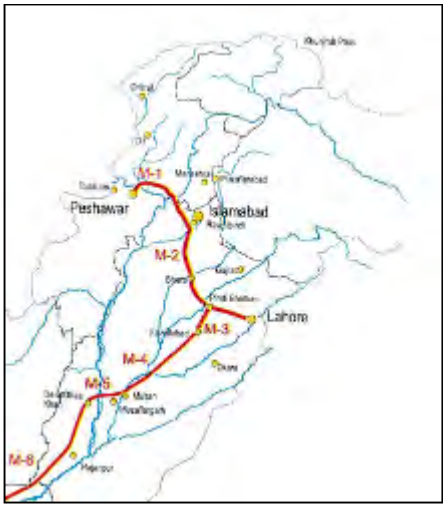
Figure 3.1.9 Motorway Typical Cross Section

Motorway (Sheikhupura Road – LRR)



Motorway (LRR – Multan Road)





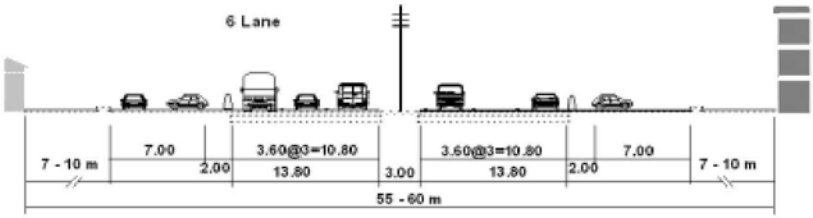
Source: JICA Study Team

b) G.T. Road (Grand Trunk Road/ National Highway, N-5)

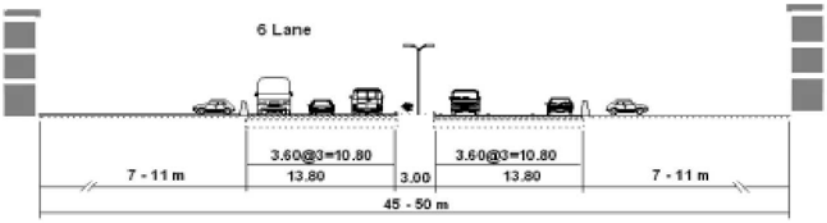
In Pakistan, there are 14 National Highways. G.T. Road (N-5) is the longest and most important highway, connecting Peshawar, Islamabad, Lahore, Multan, Hyderabad and Karachi. Typical cross section of N-5 is dual 4-lane road with median.

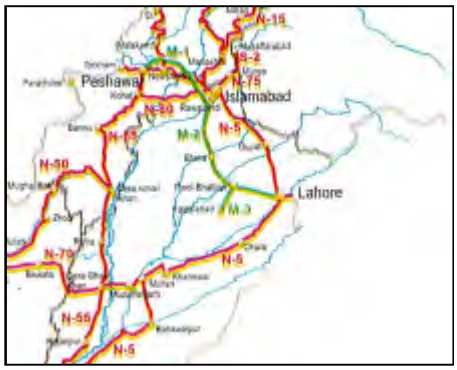
Figure 3.1.10 G.T. Road Typical Cross Section

G.T. Road (Sheikhupura Road – Ravi Road)



G.T. Road (Ravi Road – Allama Iqbal Road)



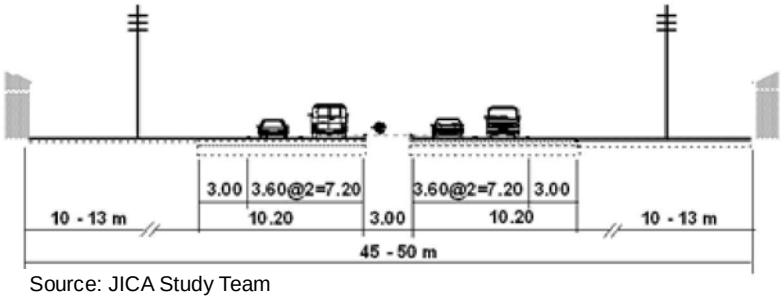


Source: JICA Study Team

The Saggian bypass was built as a bypass road to reduce traffic congestion from Lahore center area. It connects Lahore city, Kot Abdul Malik and Jaranwala and Nain Sukh. The bypass reduces congestion at Shahdra chowk and distributes traffic on Ravi Bridge.

Figure 3.1.11 Saggian Bypass Typical Cross Section

Sheikhupura Road - LRR



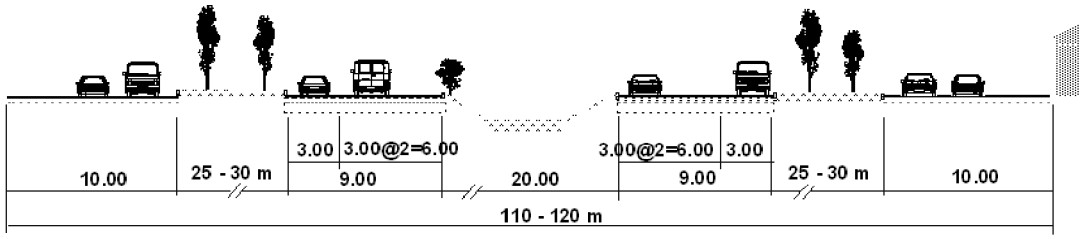
Source: JICA Study Team

d) Canal Bank Road

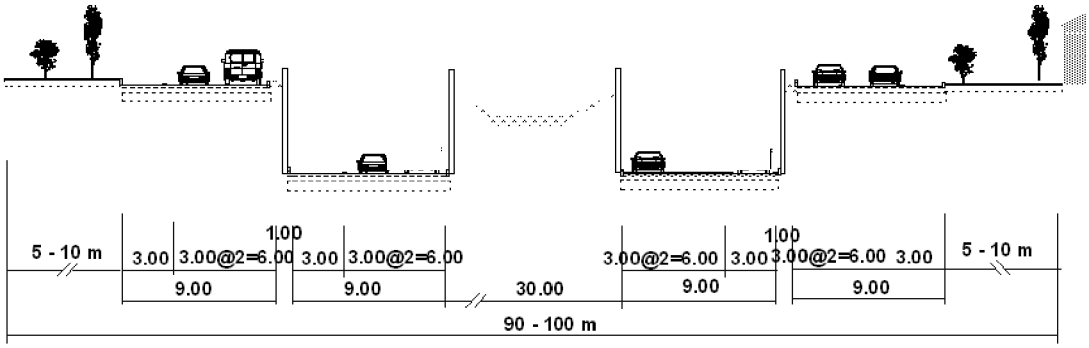
Canal Bank Road runs through the northern part and the western part of Lahore along both banks of BRB Canal.

Figure 3.1.12 Canal Bank Road Typical Cross Section

Canal Bank Road (Multan Road – LRR)



Canal Bank Road (Underpass)



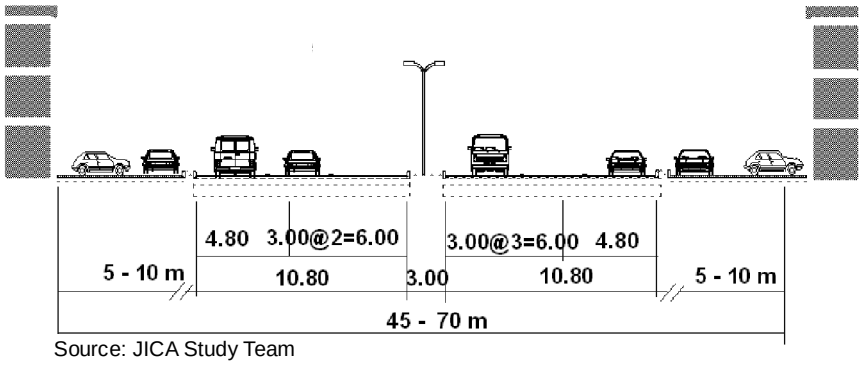
Source: JICA Study Team

e) Ferozepur Road

Ferozepur Road is a primary north-south road. It connects the city from Qartaba Chowk to Kasur District. It is one of the most important business corridors in the Study Area. There are connecting major roads like Canal Bank Road and Gulberg Main Boulevard at Kalma Chowk. Ferozepur Road has many congestion points and mostly due to mixed traffic. It is

also one of the major corridors considered for mass transit in median space scince1991 JICA Master Plan.

Figure 3.1.13 Ferozepur Road Typical Cross Section



Source: JICA Study Team

3.1.2 Problems and Issues

1) Quality of Road Infrastructure

Minimum 4-lane dual carriageways are desirable for the arterial system, but this feature is currently limited to trunk roads and a limited number of provincial roads. The main problems regarding road infrastructure in Lahore are as follows:

2) Encroachment

Lahore has the highest number of underpasses and overpass in Pakistan other than Karachi. Despite these improvements, Lahore is struggling for safety on its roads, which are dangerous because the number of vehicles overwhelms the road space, creating traffic congestion and traffic accidents.

There is no segregation between markets and roads in Lahore. All roads are market places in Lahore. The reasons are:

- Many street vendors are working to earn their daily income.
- Parking spaces are limited or non-existed in most of commercial shops and business buildings.

The solutions to remove the encroachment will not be easy because it depends on a kind of social policy. The possible solutions will be:

- The street vendors are required to develop their economy and ply their trade in markets so as to discontinue the street vending (overall economic development is needed.).
- The shops and buildings owners have to determine to invest in infrastructure for the required parking spaces for the development not park in the street.

3) Insufficient Network of Lahore Ring Road (LRR)

Half of the LRR is completed or under construction. The rest of the sections seem difficult to obtain the required land. To complete the LRR is inevitable to ease the traffic congestion in the city areas. Early implementation of the LRR is required.

4) Lack of Ravi River Bridges

Lahore has four bridges over the Ravi River. However, in the 1991 JICA Lahore Master Plan, three additional bridges over Ravi River were proposed on base of the future traffic demand. The outstanding one is from the south end of the Canal Bank Road to the north-west over the Ravi River. For the development of the city to the west of the Ravi River, addition to Ravi River crossing capacity would be required.

5) Inverted V-shaped Development to the South-west

Present new housing and industrial development schemes are mostly located in the inverted V-shaped areas between Multan Road and Ferozepur Road (south-west direction). Development towards east, north and even west is not much planned or considered except high income DHA Housing Scheme.

For the balanced development of Lahore, all directional development should be sought; otherwise more traffic will end upon Ferozepur Road.

6) Lack of Road Classification and Inventories

At present, road classification of each road is not clear and not notified by law. For the long term development and smooth implementation of each road, the classification should be well planned and the road inventories should be prepared by relevant agencies.

7) Vertical Clearance of Underpasses

In May 2010, several pupils sitting on the roof-top of a bus were killed by one of the underpasses along Canal Bank Road. Existing vertical clearances of most of underpasses varies and it generally 4m, sub-standard even with AASHTO standard (min. 4.3 m).

3.1.3 Planning Direction

1) Urban Transportation Development Integrated with Urban Growth Management

Taking into account of the factors analyzed and discussions presented in this report, basic spatial structure for the city has been prepared with the following features:

a. Proposed scenario is the compact development with improvement of living environment and mobility by development/enhancement of public transport. This scenario is friendly to people's travel, living environment and natural environment. Many of the current urban problems will be alleviated although sizeable public

investment and administrative capacity of the government are required.

b. Ribbon Development in the North should be suppressed to enhance land use efficiency in this area. The industrial estates are considered to become the relocation site of iron/ steel industries located in the north of Lahore station at present. Residential development are also planned to absorb the increasing population.

c. As this scenario assumes urban Rail-based Mass Transit System (RMTS) to be the trunk public transport system of Lahore, dense urbanization will occur along these RMTS alignments. The combination of industrial estates and academic town proposed in Ferozewala Tehsil area has a possibility to lead high-tech industrial development of not only Punjab but entire Pakistan. Though there are difficult targets of development of competitive public transport system and planned urban development, many cities in the world have overcome these issues. It is feasible if institutional and financial problems could be resolved.

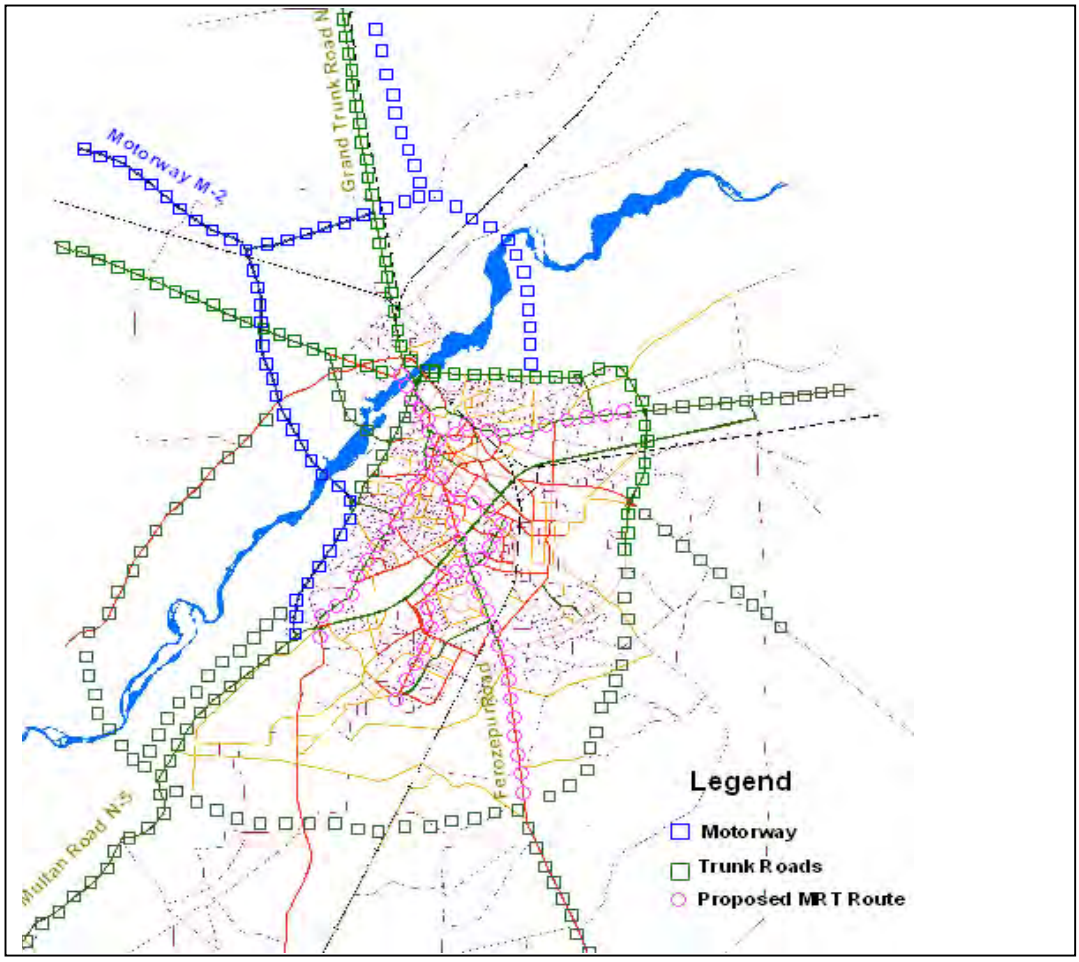
d. Transportation network will be composed of in a linear in incremental form consisting of (i) National/ regional transportation corridor, and (ii) Main urban axes which are connected with each other by lateral primary and secondary urban roads.

   National/ Regional Transportation Corridor: The corridor comprises all regional transportation networks such as Motorway (M-2) and, G.T. Road, into Multan coming from Islamabad to Lahore. The regional and inter-provincial traffic can be effectively separated from urban traffic.

   Main Urban Axes: This forms the backbone of the urban area connecting urban centres and providing access to all other main parts of the city. These axes need to be provided with efficient public transport system to ensure safe and convenient urban transport service for all groups of people. These axes would also be extended to integrate future urban areas of Punjab Province.

e. Integrated land use and urban development with transportation and environmental management is the key to realize sustainable urban form. This concept is illustrated in Figure 3.1.14.

Figure 3.1.14 Proposed Structure of Transport Network



Source: JICA Study Team

2) Proposed Basic Structure of Urban Transport Network

The basic structure of urban transport network for Lahore was preliminary formulated based on the analysis conducted in LUTMP. Urban transport infrastructures are basically planned within the Study Area.

The principles in developing urban transport network is to cater the transport infrastructure and services for various needs and functions to be satisfied, and these are described as follows:

(i) Inter-city Passenger Transport Network:

The bus terminals serving as connecting facility for intercity passengers to smoothly transfer to city transport services should be moved to more strategic location, such as RMTS terminals and future sub-urban centers of Lahore. This will provide easy transfer for passengers and re-distribution in the Study Area.

(ii) Inter-city Freight Transport Network:

Freight terminal plays an important role in intercity transport of goods to and from Lahore. A large volume of cargo is transported to/ from three freight terminals (Multan Road, G.T Road and International Airport). In order to accommodate a large volume of truck traffic, primary road network is carefully planned. In this case, the following conditions should be taken into consideration:

(a) To efficiently link several hubs of freight transport such as freight terminals and industrial zones with inter-city road network such as G.T Road (N-5) and Motorway (M-2).

(b) To avoid large volume of truck traffic entering the urban center. Hence completion of LRR is a necessity.

(iii) Road Network:

This is a combination of primary and secondary roads. A primary road network serves mainly for inter-town traffic with relatively longer travel distance. Scale and characteristics of urban development are taken into consideration of network planning. On the other hand, a secondary road network will supplement primary road network and serve for intra-district traffic with relatively short travel distance. Density of urban development is taken into consideration at network planning stage.

(iv) Mass Transit Corridors:

In order to provide efficient traffic/ transport services between major area and points where large volume of traffic demand is generated and attracted, i.e. existing and new urban centers, town centers, railway stations, airport, new development areas designated in the urban development scenario and to avoid excessive investment on road development, RMTS network serving for major mass transit corridors are planned.

(v) Other Transport Systems:

Above-mentioned major transport networks are supported by the plans for efficient and effective traffic management, walking and non-motorized transport (cycling). Roads will play the central role in developing the entire transport network of Lahore. Roads should assist other transport infrastructures to function fully to its maximum capacity.

3.2 Railway

3.2.1 Present Condition of Railway Subsector

At present there is no urban railway in Lahore. Although Pakistan Railway (PR) serves Lahore, its role is limited in the urban transport system of Lahore carrying only intercity passengers and some freight.

1) Railway Network of Pakistan Railway

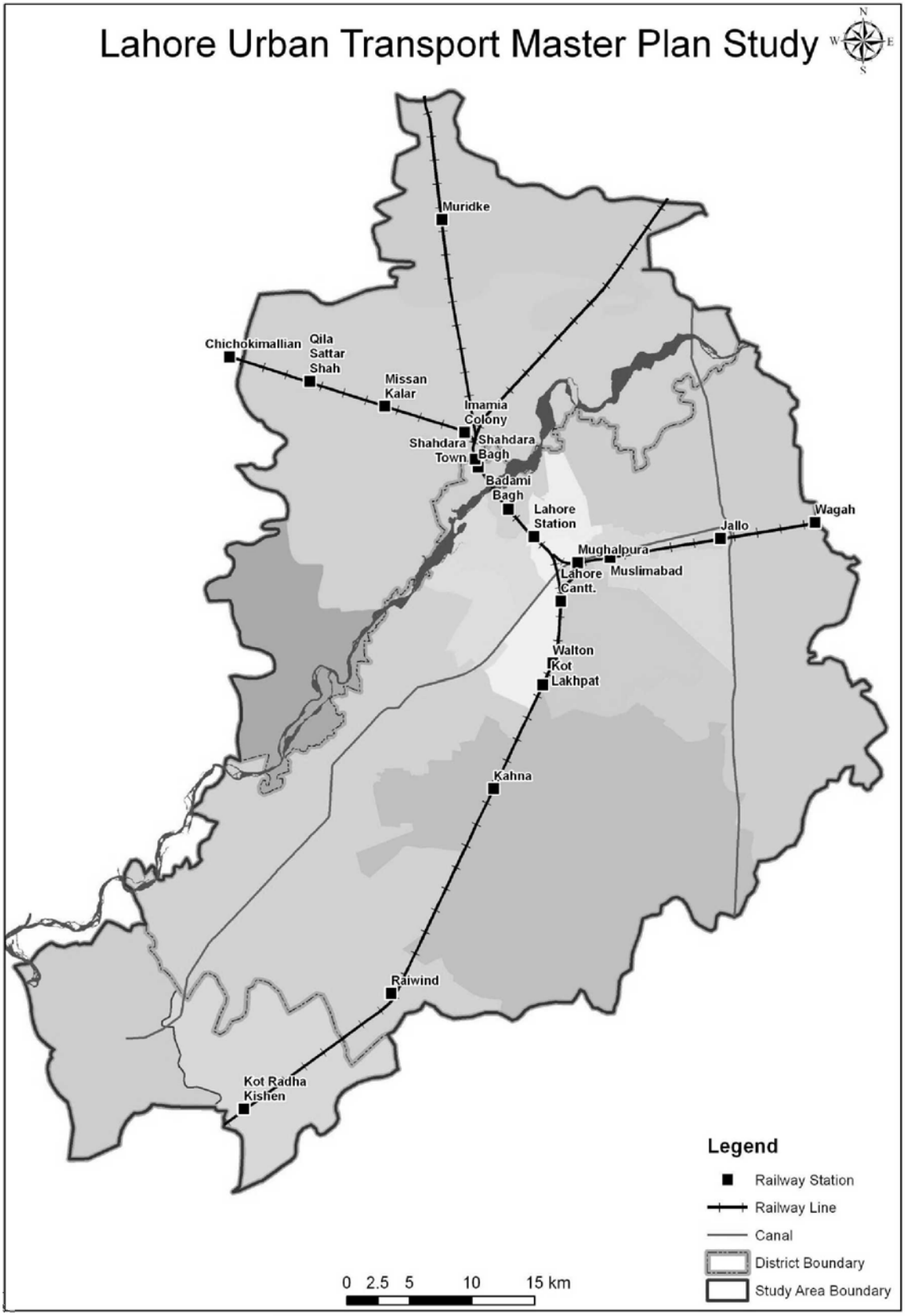
North-south line of Pakistan railway passes through Lahore with 1500km length. Within the city, there are seven railway stations including Lahore Main Railway Station which is located in the center of the city. This rail line provides inter-city passenger and cargo transport services between Rawalpindi and Karachi at the Lahore Station.

2) Pakistan Railway Stations

Lahore Station was built by British between1859-1860. The railway network established by the British was extensive and was one of their contributions to the culture and infrastructure of Punjab region. It still remains to be one of the important passengers and limited freight generating sources in Lahore. It is surrounded by residential and commercial areas. At the Lahore Station, there is a space for pick-up and drop-off of passengers and bus services are available on the road in front of the station. In 2006, the station handled 375 thousand passenger departure and arrivals.

Other stations in Lahore have a very limited role in handling of both passengers and freight.

Figure 3.2.1 Pakistan Railway Routes and Stations in LUTMP Area



Source: JICA Study Team

3.2.2 LRMTS Project

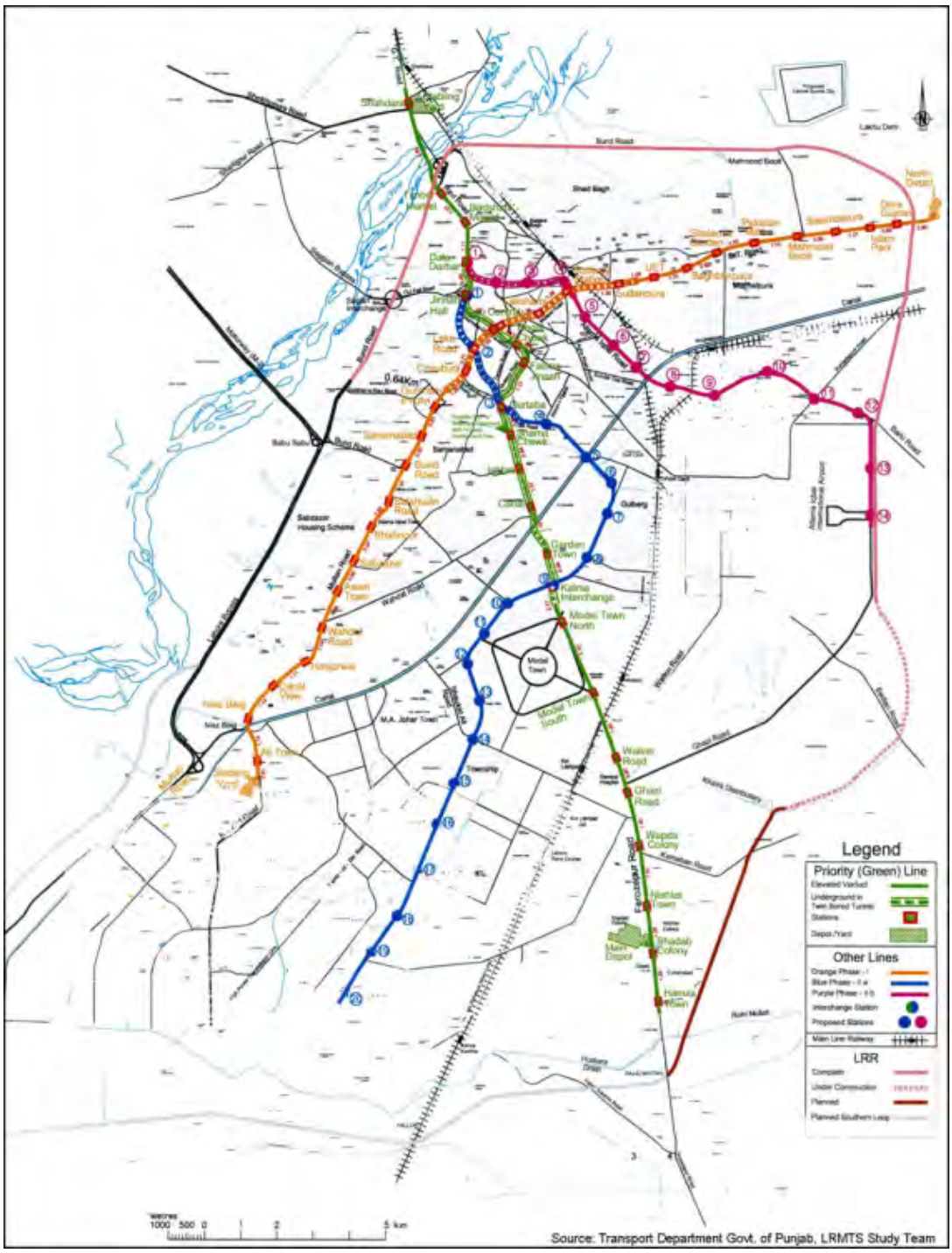
There is an urgent need in Lahore for Rapid Mass Transit System (RMTS) transport facilities to help meet travel demand. The benefit of RMTS network are that it will assist a matching demand and supply for the urban traffic system and contribute to assist in developing a sustainable transport plan for Lahore. Lahore has many of the criteria for a successful urban RMTS. With a population approaching 10 million, it is of sufficient "size" to support a successful urban RMTS. The protection plan for the historical city centre also lends itself to an RMTS solution due to limitations on potential road development and consequential road capacity problems. The supply-demand mismatch for road-space is leading to highway congestion, lower bus speeds and unreliable bus services, and therefore the opportunity for a city that desires to preserve its environment and heritage. Furthermore, there is also a need for good quality links from the suburban areas to the city centre by an environmental friendly travel mode.

1) Review of LRMTS Project in Lahore

Lahore Rapid Mass Transit System (LRMTS) is a project envisioned to provide mass transit facilities to Pakistan's second largest city Lahore. The project is expected to complete in 2025. In the first phase, two medium capacity rail based mass transit lines will be constructed. The priority Green Line between Shahdara and Hamza Town (mostly along Ferozepur Road), a feasibility study was completed in 2006, and was immediately followed by its reference design, which was completed in 2008 by SYSTRA. The Green Line was likely to be completed by 2015 at a cost of USD 2.4 billion. The funding source for the construction could not been decided. The feasibility study of the second priority line (Orange Line) was completed in August 2007. No further work has been carried on the mass transit project since June 2008. The Green Line has been treated as the priority route with an estimated EIRR of 13%.

The work on the project was stopped in June 2008. Since then there has been no progress on any component of the project. ADB had initially expressed interest in funding the Green Line capital cost by about USD 1.0 billion. This funding was contingent upon GoPb putting the project on PPP basis for raising part or all of the remainder (USD 1.4 billion) of the capital cost and to secure private sector operator. As the GoPb showed no interest in funding the project through ADB loans, the proposed financing model collapsed. Due to economic downtown GoPb alone could not afford to fund the project capital cost. As a result the project remains suspended until some form of capital cost funding could be secured.

Figure 3.2.2 Proposed LRMTS Network



Source: LRMTS Study

Phase-I:

Green Line (Total Length= 27km) - Shahdara to Hamza Town

11.6 Km-—underground in twin bored tunnels: with 12 Stations.
15.4 Km—Viaduct; with 10 Stations.

(from north to south) Shahdara, Timber Market, Data Darbar, Regal Chowk, Qartaba Chowk, Ichhra, Canal, Kalma Chowk, Model Town, Walton Road, Wapda Colony, Shadab Colony, and Hamza Town.

Orange Line (Total Length=27 Km) – Dera Gajran to Ali Town

6.9 km—underground with 6 Stations in twin bored tunnels
20.2 Km—Viaduct with 20 Stations
(from east to west) Dera Gajran, Islam Park, Salamatpura, Pakistan Mint, Baghbanpura, UET, Railway Station, Lakshami, Chauburji, Samanabad, Shahnoor, Sabzazaar, Wahdat Road, Canal View, Thokar Niaz Baig, and Ali Town.

Phase-II

Blue Line (Approximate Total Length=24Km) – Jinnah Hall to Green Town

4.0 km—Underground with 3 Station
20.0Km—Viaduct with 17 Station

(from north to south) Jinnah Hall, Qartaba Chowk, Gulberg, Garden Town, Moulana Shaukat Ali Road, Township, Green Town.

Purple Line (Approximate Total Length =19Km) – Airport to Data Darbar

3.4 km—Underground with 4 Station
15.6 Km—Viaduct with 10 Station

(from east to west) Airport, Barki Road, Allama Iqbal Road, Data Darbar.

2) Issues of LRMTS

(i) Electrification System

The 3rd rail 750 DC system was assumed as power supply source. This system has been used at first for a subway in Tokyo, i.e., MARUNOUCHI Line and GINZA Line and recently used in urban railways in Bangkok called Sky-train. This system has an advantage to minimize the tunnel cross-section as much as possible, and electric poles would not be constructed on the viaduct, however this system has safety disadvantage because of existence of high voltage equipment at lower part beside the train. Along at-grade section

in Depot, safety measures would be required for the maintenance staff.

(ii) Structure

In the feasibility study of LRMTS, U-shape girder is proposed as standard viaduct structure. Concrete girder surrounds lower part of railway track, and it states this style as environmentally friendly. U-shape girder has been also constructed in Japan only at unavoidable section, i.e. where necessary height under the girder cannot be secured and normally deck girder like PC box-girder, PC T-shape girder, and so on has been used as viaduct structure. This girder called SYSTRA U-shape Girder has been used in Delhi Metro, Santiago in Chile, Dubai Metro in the United Arab Emirates, Taipei Metro in Taiwan, and recently in Korea. Currently many urban railways using viaduct have been constructed all over the world, deck girder such as PC box girder has been used in most cases. Because of main girder is located beside railway tracks, the supporting pier has to overhang outside, and widespread lower bottom part of the girder may seem oppressive to the people. Delhi Metro in India used PC box deck girder at first, and later U-shape girder was used at extension section. The deck type PC box girder is also suitable for urban viaduct structures, but the U-Shape tend to be cheaper because of overall lower height.

(iii) Earthquake Resistant Designs

According to the “CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES: Fifth Revision”, (Bureau of Indian Standards), a huge earthquake of a magnitude of about 8.0 had happened at approximately 500 km north-east of Lahore. Therefore, earthquake resistant design would be required for urban railway structures in Lahore city. This would need to be checked at detail design stage.

a) Avoid top heavy structure

The standard viaduct pier presented in the Feasibility Study report is of single column type. The entire superstructure's load should then be supported by the independent column. However, sufficient reinforcement of column may be quite difficult in case of major earthquake. If possible, two columns type may be studied and evaluated at detail design stage.

b) Strengthen for shearing force

The structure will be designed based on destruction by Bending Moment. Destruction by Shearing Force should be considered for easy repair after earthquake damages.

c) Study at supporting point of superstructure

Sufficient length from the support of superstructure to the edge of supporting beam in

sub-structures shall be secured to prevent falling of superstructure, and some counter measure equipment of girder will be also required.

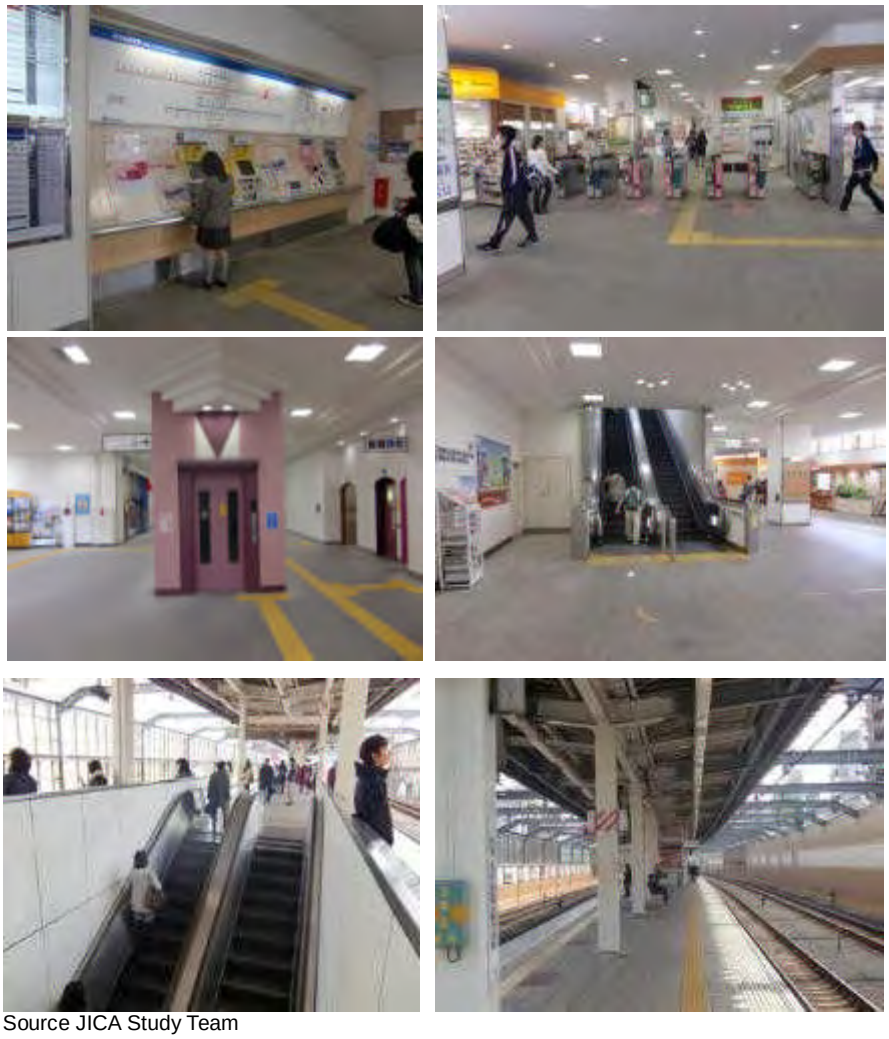
d) Length from Pile edge to end of footing

The length between pile edges to end of footing shown in drawings seems extremely short. The check of Push-out Shear Stress is quite important in seismic case, because big pile reaction will occur in an earthquake.

(iv) Assistance for Handicapped Person

Elevator and wheelchairs have been proposed in the design report for the aged and the handicapped. In addition to these, Braille paving block for blind people may also be provided at LRMTS stations. For reference, an example in Japan at NAKAMURABASI Station, Seibu Railway, Japan is shown in the figure 3.2.3.

Figure 3.2.3 Yellow Braille Block, Nakamurabashi Station, Japan



Source JICA Study Team

(v) Others Issues

a) Steel bar arrangement drawings

Drawings of steel bar arrangement are not found in the design report. Reinforcement of column in the seismic loading case and support in the beam around shoe of substructure and others should be considered at detail design stage.

b) Platform length

In the LRMTS report platform length is set at total train length+5.0 m. However, because of high density of train operation and mass transport passengers, platform length of urban railway is decided at total train length+10m in Japan. However, this may not be necessary as all platforms will have screen doors excluding the platform area to avoid accidents – unlike open platform as in Japan.

3.2.3 Planning Direction

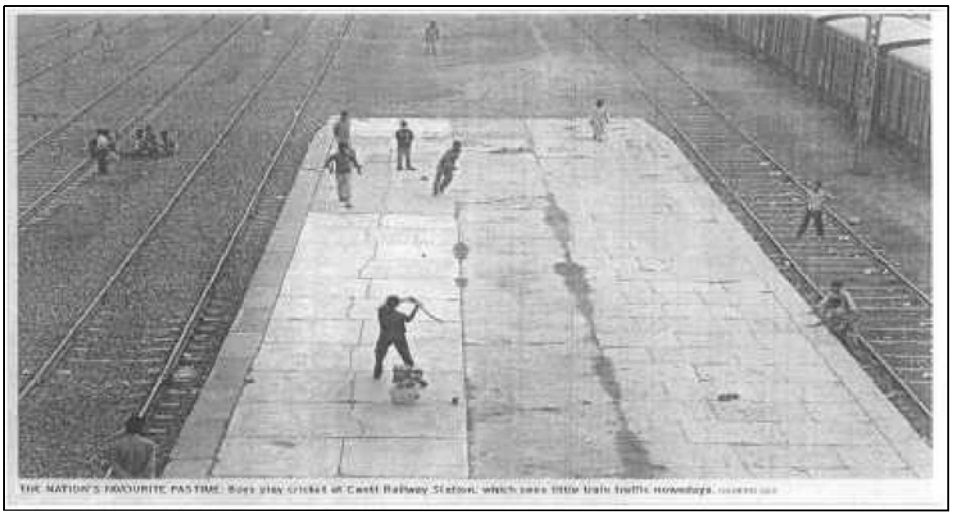
1) Limited Potential of Using Pakistan Railway for Urban/ Suburban Transport Service

The operation of Pakistan Railway has declined as mentioned earlier. Actually, for the short- to medium-term, it is almost hopeless to use Pakistan Railway as an urban transport service in and around Lahore due to depilated tracks, signal system, lack of train/ platform capacity etc.

Pakistan Railway needs entire restructuring as the national railway. Various initiatives have been taken to re-vitalize Pakistan Railway, but all have failed. If urban or suburban railway is operated in Lahore as a part of Pakistan Railway or using the Pakistan Railway assets, its operation will be affected by the current intercity operation of Pakistan Railway. New trains and other facilities including signal and communication equipment purchased or installed for the urban/ suburban service would be used together with the existing totally obsolete assets of Pakistan Railway. Under these circumstances, safe and modern operation of railway is almost impossible.

In the long run, however, the potential of Pakistan Railway in urban transport service should not be ignored. If restructured and totally modernized, there will be opportunities for PR to become a major supplier of suburban transport service in the Study Area.

Figure 3.2.4 Playing Cricket at Lahore Cantonment Station



Source: Lahore News, Oct 12, 2011

2) Urban Railway Development

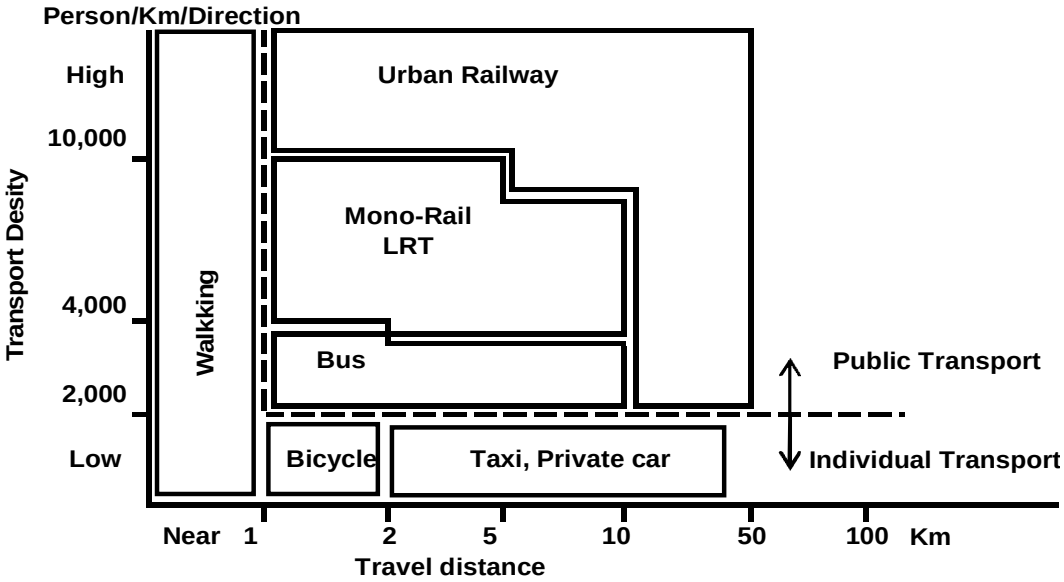
(i) Key Principles

The weakest point of the railway is inferior in door-to-door service while this point is the strongest merit of personal (individual) transport. It is so difficult that the people who use personal transport are highly unlikely to shift to the railway. Thus it is most essential to raise comfort, convenience and accessibility of urban railway to the maximum extent to have enough patronage for the railway. Therefore the following points should be reasonably incorporated in the plan.

- Connectivity between railway terminals/ stations and activity centers.
- Appropriate station location and interval.
- Safe and well-organized operation through trained railway staff.
- Rapid train operation to be competitive with road transport journey time.

Although there are a number of transit systems in the world such as LRT, MRT, Monorail, etc, most suitable railway system should be selected by comparing transport demand with transport capacity in addition to the points disused above.

Figure 3.2.5 Classification of Urban Railway System



Source: JICA Study Team

(ii) Railway Management

The management of urban railway should be in charge of the private sector. For operating urban railway after construction, a lot of expenditure is required; i.e. huge initial construction cost, equipment purchase, various facilities maintenance cost, interest charges and so on, and gross revenue from passenger fare is limited. Therefore revenue and expenses do not balance just after opening. Public subsidy/ assistance to cover this imbalance, presumably in the form of PPP, will be necessary for realization of the railway business. The scheme of "Separation of Infrastructure and Operation" could be adopted as it was applied to many railways in the world.

Urban railway's management will require modern technology and engineering in various fields since railway is a “system”. Principal issues are enumerated as follows;

(iii) Operational System

Entirely simple system that needs less man power should be used as much as possible to curtail expenses. Introduction of latest model equipment should be considered based on the comparison of increasing capital investment with decrease of manpower expenses.

a) One-man operated train

One-man operated train will be suitable if passenger safety is ensured and traffic accident can be handled properly.

b) Simplify the driving system at station

Railway operation will be operated by Central Control Room, and passengers ride on and

off should be managed by driver as much as possible. Station-staff who takes charge of unusual occasion could be concentrated at major stations and dispatched from there.

c) Mechanization of ticket vending machine and ticket gate

Automated ticket vendor and ticket gate should be introduced as much as possible, as proposed by LRMTS Studies.

d) Institution of unified order system

Unified order system in emergency of train operation is absolutely necessary to minimize serious accident and resume train operation. It is desirable that all senior engineering staffs are concentrated at Central Control Center

(iv) Maintenance System

a) Integration of various technology

Railway engineering includes track works, power, signal, telecommunication and rolling stock. Hence, many workplaces have been conventionally provided individually, but since railway is a system technology, workplaces should be designated to enable closer cooperation.

b) Introduction of foreign technology

When technical problem arises, application of foreign technology should be positively considered for outsourcing.

3) LRMTS Project as LUTMP Proposal

In the light of the magnitude of traffic demand, its distribution and the need to shift mode choice from private to public, JICA Study Team considers that the existing LRMTS proposals are quite reasonable.

Table 3.3.1 Inter-city Bus terminals in Lahore

Station No.	Name	Location
1	Larri Adda	Badami Bagh
2	City District Government Lahore Terminal	Bund Road
3	Niazi, Abdullah and Skyways Terminal	Bund Road
4	New Khan, Rahber and Kohisatn Terminal	Bund Road
5	Daewoo Bus Terminal	Ferozepur-Road
6	Shahdara	G.T. Road

3.3 Road-based Public Transport

3.3.1 Present Conditions of Road-based Public Transport

1) Bus Terminal

Lahore has three different types of bus terminals, one an intercity bus terminal; other is inner-city bus terminal and private bus terminal. Intercity bus terminal provides services for other city.

2) Public Transport Structure and Organization

The government has further encouraged the private sector in public transport operation, and the current public transport structure in Lahore is a direct heritage of the 1998 transport policy review, which revamped the structure of public transport services. The franchise scheme was introduced in 1999 by support of the government through the Transport Sector Development Initiative (TSDI).This promoted a privatization and deregulation of public transport, while government agencies only to regulate the services. New private operators then entered the market, increased the number of buses in operation and significantly improved the public transport situation in Lahore since 1999.

The public transport administration, policy making and planning in Punjab is coordinated by the Punjab Transport Department, which was established in 1987 under the West Pakistan Motor Vehicles Ordinance 1965. It is responsible for the licensing of high-occupancy bus services in Lahore and other large cities, and of public transport services outside the major cities of Punjab through the Punjab Provincial Transport Authority (PPTA). Minibus routes are granted by the Lahore District Road Transport Authority (DRTA), which was established in 2001 by the Punjab Transport Department, and reports to the City District Government of Lahore (CDGL) and PTA.

However, in the 2000s the government's attention shifted to other projects (road projects, LRTMS, and 4-stroke rickshaws), and as the bus system in Lahore received little consideration the improvements seen since 1999 stopped and the situation worsened in the past few years. The number of buses in operation stated to decrease from 2008 due to poor maintenance, lack of investment, and competition with the other road-based modes (wagons). Between 2008 and 2010 no operator entered the market and no bus had been added to the depleted fleet.

While the number of buses declined and private operators were unable to meet the overall demand, the services of public transport were provided by smaller, private vehicles such as Wagon, Rickshaw and Qingqi, which have had a significant growth over the last decade.

In an effort to improve the situation of road-based public transport, the Lahore Transport Company (LTC), a state-owned company, was established in December 2009, taking over the infrastructure and regulation responsibilities from the DRTA Lahore office.

LTC is primarily a regulation body and is now the sole organ responsible for custody of all public transport infrastructures in Lahore and its operations through a network of private operators. Infrastructures include bus stops, shelters, bays, depots and terminals, while the regulation and operational aspects cover service routes and the buses provided by and operated through a network of private operators.

3) Bus Service

Bus service in Lahore was planned over 53 routes, based on 2006 survey of passengers and published in Punjab Gazette 2006. However, only 30 routes are operated due to lack of supply and demand. Most public transport is served by non-operational bus routes with non-registered wagons, coasters, rickshaws and Qingqis.

Recently, several bus companies operate in Lahore. Premier Bus Services, owned by the Beaconhouse Group, have started in 2003. It provides premium transportation services to the general public of Lahore, with hundreds of buses running on exclusive routes. This is the largest public transport service provider in Lahore. The buses are in the process of being converted to Compressed Natural Gas (CNG) for environmental and economic reasons, and Daewoo City Buses provide high-end (higher fare) city and inter-city public transport. Though these buses are fewer in number, these are air conditioned and provide better comfort to passengers. In addition to these two major companies, there are several other small companies (New Khan Metro, Niazi etc.) that provide services within Lahore; they cover only particular routes and are limited in number. The urban bus operation is regulated through Lahore Transport Company (LTC), setup by the GoPb.

Figure 3.3.1 Daewoo City Bus

Source: JICA Study Team

4) Minibuses and Wagons

Many public transport vehicles operate without valid license, current registration. It has also been reported that many wagons and coasters driven by drivers without licenses, and that many do not follow the authorized route, providing services to neighboring towns and illegally competing with urban bus although they are not allowed to serve urban passengers.

Wagon and bus routes should normally be controlled and enforced by DRTA now LTC, but the inefficiency of public-owned public transport has led to increase of private vehicles mostly motorcycles.

5) Auto-Rickshaws and Qingqis

The number of rickshaws operating in Lahore is estimated to be 66,000 as per registration data of the Lahore District Registration Authority, but up to 80,000 may actually ply the routes of Lahore when taking into account unregistered vehicles. About 5,000 route permits have also been issued for Qingqis, but it is estimated that as many as 40,000 are currently operating in Lahore, many along primary and secondary roads which are also served by licensed bus services. While there has been no change in the design of the auto-rickshaws over the last 4 decades, the government is currently trying to ban two-stroke engines in favour of CNG four-stroke rickshaws.

6) Mode Share

Tables below show estimated mode share and trip-making in Lahore by TEPA for 2007 and by the JICA Study Team for 2006 and 2011. The proportion of non-motorized trips is high, at 45%, while the proportion of public transport trips among motorized trips is around 35% (TEPA) to 38% (LRMTS). There is a declining trend of public transport mode share in proportion in favour of car and motorcycle trips, but considering the growth of population and trip-making, the actual number of trips made with public transport services will increase over the next decade.

Table 3.3.2 Estimated Daily Trips in Lahore (TEPA)

Mode		Trips (,000)	Proportion
Public Transport		3,409	19.3%
Private Vehicles	Cars	2,894	16.4%
	Motorcycles / Bicycles	3,314	18.8%
Walk		8,050	45.6%
Total		17,667	100%

Source: TEPA, 2007

Table 3.3.3 Estimated Daily Motorized Trips in Lahore (LRMTS)

Travel Mode	2006		2011 (Forecast)	
	Total ('000)	Proportion	Total ('000)	Proportion
Motorcycle	1,292	18.5%	1,532	18.3%
Rickshaw	1,014	14.5%	1,157	13.9%
Car/Taxi/4WD	1,991	28.5%	2,561	30.7%
Public Transport	2,699	38.6%	3,100	37.1%
Total	6,996	100.0%	8,350	100.0%

Source: LRMTS Study, 2007

7) Operational Details

The table below shows the distance bands and fares for bus and wagon routes.

Table 3.3.4 Bus and Wagon Fares, June 2010

Distance (km)	Fare (PKR)
0 – 4	13
4.1 – 8	18
8.1 – 14	22
14.1 – 22	25

Source: JICA Study Team – Transport Dept. GoPb.

Bus fares have significantly increased since the introduction of the franchised scheme, as they had started at only PKR 3 for the 0-3 km distance band (representing more than twice the 1999 price when taking inflation into account).

The cost of free of charge ridership those are not paid is high, and is estimated at 10 to 15% of all passengers according to a study for TD, GoPb.

Table 3.3.5 Outline of Bus Operation

Specified headways (minutes)	Peak	5.7
	Off Peak	8.2
Observed headways (minutes)	Peak	9.3
	Off Peak	11.5
Average speed (kph)		19
Passenger trip length	<=4 km	39.9%
	<=8 km	66.5%
	<=14 km	89%
Bus kilometres (km/day/bus)		234
Operating cost (PKR/km)		29

Source: Transport Department, GoPb

3.3.2 Current Problems and Issues

The public transport network in Lahore is currently under-developed, fragmented, inadequately managed and highly inefficient.

1) Under-Development

More than 800,000 passengers use public transport in Lahore where about 500 high occupancy buses are operated by 13 private companies. Evidently the public transport network is under-developed and there is a great gap between the demand and provision of an efficient and environment friendly public transport. Despite a considerable demand and several projects (Green, Orange, Blue and Purple Mass Rapid Transit lines), there is currently no MRT line in Lahore.

2) Fragmentation

Historically, the provincial governments in Pakistan have owned and operated intercity and urban public transport services. However, over the years, the government, according to the guidelines of the World Bank, advocated to encourage the private sector in operating public transport. The decline of state-owned public transport services created a vacuum that was filled by private operators in accordance with these guidelines. Initially, the market was opened to private operators in parallel with public-owned public transport. However, the availability of public transport has not grown at the same rate as the population. Therefore, a large number of small private operators were permitted to fulfil this gap in a fragmented way. As a result, a chaotic mass of individually-owned small vehicles (Wagon, Qingqi, Rickshaw etc.) operate in Lahore, competing for road space.

3) Inadequate Public Transport Management

Public transport organizations have a long history of deficiency in professional, administrative, and financial capacity to manage public transport services. In the absence of human resources, coordination, research, and financial capacity of public transport institutions in Punjab, public transport has now become fully the prerogative of the private sector as described in the previous paragraph. The incomplete bus routes, high fares, fewer-than-required buses, gender discrimination, and even absence of bus routes in parts of urban areas is common. Whole public transport is grossly mismanaged with least objective of service provision, limited and inadequate condition of the public transport facilities (including bus terminals and buses) and chaotic use of road space due to traffic mix. Public transport operations should be improved by extending franchised bus operations along major corridors and restricting small vehicles operations to feeder routes. It will require emphasis on high-capacity buses rather than a multitude of smaller vehicles.

Transport related functions (transport planning, engineering and maintenance, and licensing, registration, regulation and operation of public transport routes) hence, not concentrated into one single and efficient authority: public transport routes and the definition of stops are under the control of the GoPb Transport Department, DRTA issues

the route permits for wagons on behalf of the Transport Department. TEPA has no longer any involvement, and licenses are issued without the assistance of any transport planning processes.

4) Performance

Due to rapid motorization (majority motorcycles) increase and traffic volume over the last two decades, the road network has many congested sections in cities and towns along the roads, which increases travel delays and reduces bus travel speeds, implying a less competitive public transport network, especially in the Central Business District where commercial and trading activities are located.

Current public transport services are suffering greatly due to irregularity. On certain routes waiting times for the passengers are too long whereas on other routes buses wait for passengers and may move when feel. Such a situation prevails because routing and licensing is not based on passenger demand analysis but based on convenience of operators and lack of regulator ability to assess. Efficiency is acceptable on certain routes but reliability is poor, there being no scheduling at all.

3.3.3 Current Plans and Practices

1) Multimodal Inter-City Bus Terminals in Lahore *(a Transport Department Project)*

Lahore has two (2) general bus stands under City District Government of Lahore, and eleven (11) private inter-city bus terminals. All bus terminals are inside the city area, which results in traffic congestion in those areas, and leading to these terminals. Currently, Transport Department intends to shift existing bus terminals to the outskirts of city including major bus terminal at Badami Bagh.

Project Description:

Construction and operation of 3 inter-city bus terminals in Shahdara, Ferozepur Road near Hudyara Drain and Thokar Niaz Baig/ Ex-PRTC Workshop Sites on Build Operate Transfer/ Public Private Partnership basis

Status:

Request letter has been written to Senior Member Board of Revenue to transfer land owned by Industries Department in favor of Transport Department. Thokar Niaz Beg land is already owned by Transport Department, which is temporarily under the use of Traffic Police.

Feasibility study for Thokar Niaz Beg bus terminal is being conducted for Transport Department. Expressions of Interest (EOI) for the Transaction Advisor (TA) to manage these studies were advertised on 31st January, 2011 by Transport Department. EOI for the potential bidders to be shortlisted would begin shortly after the TA is on-board.

Location/ Area:

Locations of Shahdara, Ferozepur Road near Hudyara Drain and Thokar Niaz Beg (Lahore) are shown in the following figure.

Estimated Cost:

No Cost Estimate is available.

Financial Source:

(i) GoPb transaction advisory services and land costs

(ii) Build operate transfer/ public private partnership for construction and operation

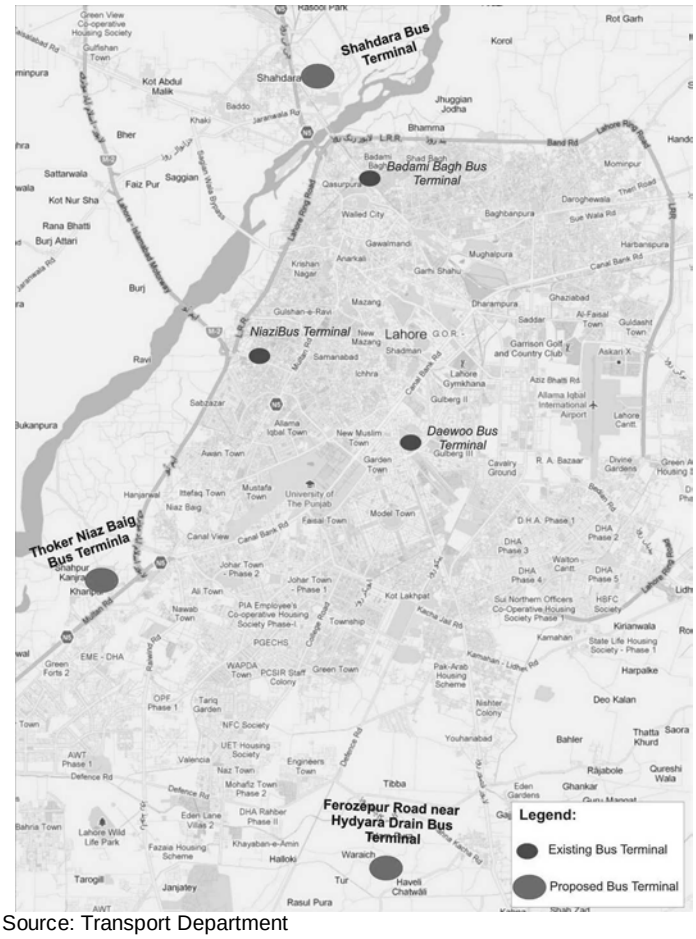
Schedule:

2011 – Onward

Implementing Authority:

Transport Department, GoPb, in coordination with City District Government of the Lahore

Figure 3.3.2 Location of Multimodal Intercity Bus Terminal



Source: Transport Department

2) Effective and Efficient School Bus Service (*a Transport Department Project*)

During peak periods, most of the road space is occupied by the cars meant for dropping and picking up school children. It is believed that an effective and efficient "School Bus

Service" may reduce the number of cars used for this purpose.

The Transport Department is preparing a plan in consultation with Education Department with the following objectives to provide School Bus Service:

- To improve enrollments in government schools
- To achieve maximum attendance
- To ensure efficient and productive use of time
- To ensure safe, quick and direct access to schools
- To provide comfortable and efficient transport service to students
- To reduce the risk of road accidents
- To reduce congestion
- To provide alternative to the parent's duty

Project Description:

- No. of routes have been established on the basis of geographical mapping of school and its pupils
- No. of buses on each route will be allocated keeping in view the ridership
- Pick-up point of each route will be notified to the parents/students through electronic/print media
- School routes will be notified by the Transport Department in consultation with the Education Department.

Table 3.3.6 Expected Beneficiaries and Required Bus Fleet

City	High Education Secondary Schools	Enrollment	Beneficiaries (50% Enrollment)	No. of Buses (53 Seat/Bus)
Lahore	230	229,139	114,570	2,162
Rawalpindi	72	49,902	24,951	471
Gujranwala	43	43,608	21,804	411
Multan	48	68,154	34,077	643
Faisalabad	82	104,683	52,342	988
Bahawalpur	31	28,118	14,059	265
D.G. Khan	13	15,333	7,666	145
Total	519	538,937	269,469	5,085

Source: Transport Department

Terms and Condition (Source: Transport Department):

i. Buses will be provided by the Government
ii. Buses will ply on specified routes to be determined by Government in the seven cities to provide free pick-up and drop-off services to students
iii. Buses will be exclusively used for school students
iv. Operators will ply these buses as per time schedule given by the Government
v. The Government will provide overnight parking space

vi. Registration, Fitness, Insurance, Token Tax and Diesel/lubricants will be borne by the Government. All other expenses will be borne by the operator
vii. The operator will submit re-imbursement claims by adding 15% to actual expenses as profit margins
viii. The Government will reimburse the claims within one month
ix. The operator(s) selection, monitoring, and inspection shall be carried out under the supervision of respective DCO
x. The operator(s) shall not be allowed to assign, sublet or subcontract whole or part of service of the operation
xi. The operator(s) shall maintain adequately equipped automobile workshops. They may enter into an agreement with some suitable workshop
xii. Separate Section in the bus shall be provided for female students
xiii. The Government shall have the right to check the operation to ascertain whether service being provided is in accordance with the agreed terms and conditions
xiv. The operator(s) shall be responsible for any loss which may arise as a result of accident/damage
xv. Performance Guarantee Deed will be executed with the operator(s)
xvi. Initially, the agreement with the operators to launch School Bus Service will be for three years

Location/ Area:

Lahore, Rawalpindi, Gujranwala, Multan, Faisalabad, Bahawalpur, and D.G. Khan

Estimated Cost:

Total cost of providing 5,085 Buses in seven major cities of Punjab is estimated to be PKR17.8 billion.

Table 3.3.7 Anticipated Cost of the Overall Project

City	No. of Buses	Total Cost (PKR millions)
Lahore	2,162	7567.0
Rawalpindi	471	1,648.5
Gujranwala	411	1,438.5
Multan	643	2,250.5
Faisalabad	988	3458.0
Bahawalpur	265	927.5
D.G. Khan	145	507.5
Total	5,085	17,797.5

Source: Transport Department – Cost of one bus is PKR 3.5 million

For Pilot Project with 100 Buses the cost comes to PKR 350 million

Table 3.3.8 Anticipated Cost of Pilot Projects

City	No. of Buses in Pilot Project	Cost of Pilot Project (PKR Million)
Lahore	35	122.5
Rawalpindi	15	52.5
Gujranwala	10	35.0
Multan	10	35.0
Faisalabad	15	52.5
Bahawalpur	10	35.0
D.G Khan	5	17.5
Total	**100**	**350**

Source: Transport Department

Fuel Cost/ Bus/ Year: PKR 265,400
Management/ Maintenance Cost/ Bus/ Year: PKR 306,000
Operational Cost/ Bus/ Year: PKR 571,400

Financial Source:

GoPb: Buses Fleet, Operation and Maintenance

Private Operator: Management Cost

Schedule:

2011 – Onward

Implementation Body:

Transport Department in Collaboration with Education Department

3) Up-gradation of Bus Stands– (*a Transport Department Project*)

Operational efficiency of the General Bus Stands in Lahore city is not up to the mark, and regarded as poor ambience and service control by general public. Locations of these stands are still questionable. There is no mechanism of revenue and expenditures control, this is resulting in enormous amount of pilferage, causing extra charging to passengers by bus operators.

GoPb, Transport Department has a vision to change the mishandling of finance and operation of bus stands by enforcing proper revenue generation and collection mechanism. This includes expenditure control of each bus stand, control of fares and bus operators charges, providing facilities to passengers providing parking, bus bays, intra-city feeder services.

Project Description:

Transport Department completed in-house survey of two (2) main bus stands. The Urban Unit is working on concept paper and proposal for improvement of Government owned bus stands in the Lahore City. Components of the functional Bus Stand to be identified and proposed so as to develop air-port style facilities for meeting and matching passenger needs and comfort. Four such bus stands have been proposed in Lahore to meet the

demand. Lahore Urban Transport Master Plan study proposals will be considered in this regard for future steps in development of General Bus Stands in the Lahore Area.

Status:

Project is in the inception stage.

Location/ Area:

Lahore District

Estimated Cost:

No cost estimates are available.

Financial Source:

GoPb or Public Private Partnership

Schedule:

2011 – Onward

Implementation Body:

Transport Department, GoPb

4) Integrated Bus Operation (*a LTC Project*)

Preliminary analysis shows that there is excessive overlapping of routes as classified in Gazette 2006, and many routes are not operational since their classification. LTC recommended re-organization of routes to reduce overall travel distance and offered routes on public private partnership, to attract investors and solve most of the problems of existing system of 'notified' routes operation. It is expected that integrated bus operation will reduce daily bus travel-km by approximately of 100,000km. Further, saving of time, elimination of illegal transport, better headway, attractive to investors for operation are other benefits of the project. Buses will operate in the system on trunk and feeder system with classification of vehicle type on the basis of passenger demand as opposed to the existing system, where all current routes are classified for large buses.

Project Description:

Feasibility study will be prepared after LUTMP.

Projects Components:

1. Built-transfer –lease of routes i.e. offering routes on the basis of per km of operation to bus operator;
2. Bus management system and E-ticketing system;
3. Construction of bus stop shelters.

Note: Re-organization of routes considering LUTMP recommendations.

Status:

LTC is waiting for the Study final report, particularly with regard to the trunk public transport system. RfP has been issued for the Bus Management and E-ticketing system. Bus shelters have been proposed on different important corridors at appropriate locations. There will be constructed through private sector involvement.

Location/ Area:

Lahore District

Estimated Cost:

PKR 6,410 Million

Financial Source:

Lahore Transport Company: E-ticketing and Bus Management System
Private Bus Operators: Buses

Schedule:

No Schedule available.

Implementation Body:

Lahore Transport Company

5) Establishment of Multimodal Bus Terminal(Shahdara) – (*an Urban Unit Project*)

Sheikhupura district population was about 2.9 million in 2000. The city is well connected with its surrounding urban centres like Lahore, Faisalabad, Sargodha and Gujranwala. Parts of Sheikhupura District, Tehsil of Sharaqpur, Ferozewala, and Muridke are in the the Study Area.

Presently there are 2 bus terminals operational in Sheikhupura city:

- 32 Chowk Bus/ Wagon Stands
- Daewoo Bus Stand at Sultan Colony

But these are operating without any proper facilities and even lack basic public amenities. These bus stands are incapable of handling current demand of public Transport. The buses and wagon are using the road-side for their daily operations; this situation is creating traffic congestion. In this regard, a multi-modal bus terminal facility is required to be built to cope with the problems and to facilitate the public transport passengers. The purpose of multi-modal bus terminal is to provide fast and efficient multi-modal terminal facilities for inter and intra-city travel.

Project Description:

The word “multi-modal” has been used, it means a comprehensive multi modal transport

has to encourage best fit model to the economy and needs of the hour. This will be a multi-modal including truck/ freight terminal.

Status:

Land has to be identified and acquired, which is in process. Later on contractor and consultant will be hired to do the construction and supervision job respectively.

Location/ Area:

Sheikhupura Lahore Bypass, location has to be finalized yet. Proposed area for bus terminal is shown below in Figure 3.3.3.

Estimated Cost:

No cost estimates are available

Financial Source:

City District Government of Sheikhupura, GoPb

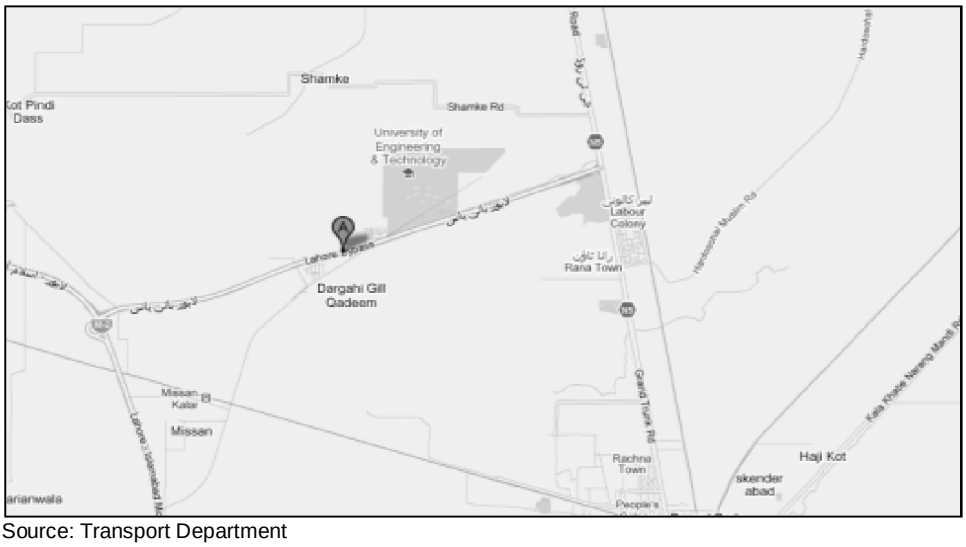
Schedule:

2011 – Onward

Implementation Body:

City District Government of Sheikhupura

Figure 3.3.3 Proposed Area of Shahdara Multi-Modal Bus Terminal



Source: Transport Department

6) Bus Rapid Transit (BRT) System Study (a LTC Proposal)

A Korean Group of investors have expressed interest in providing BRT system along the LRMTS Green and Orange Lines corridors on BOT basis. The GoPb has requested the Korean investors to prepare detailed feasibility study, giving details of technology, financing and implementation plan for a BRT system along both corridors. The feasibility report was expected in February 2011 but it has not been submitted until November 2011.

7) Monorail System in Lahore

An international group (lead by Malaysian Co.) has recently submitted an unsolicited bid to build and operate a monorail system along the Green Line alignment on BOT basis. The proposal is currently being examined by the GoPb for its viability and characteristics. The technical specifications of the proposed system are also being scrutinised and confirmed. Some relate to the bidders 'claims' regarding the system capacity, operational characteristics, source of funding, hence its technical and financial viability is in question. As a result, there has been no decision as yet on implementing a Monorail system in Lahore.

3.3.4 Main Planning Issue

Transport, accessibility, and mobility are arguably the single biggest issue raised by Lahori citizens as a severe problem in their daily lives as they suffer the stress of traffic congestion and reducing mobility in the city. The human toll in terms of lost time, opportunity effects on health and education and employment are vast, and its effects on society will be generational. The city as a whole carries a large social and economic cost, and incurs environmental degradation from the effects of traffic congestion.

Lahore city has a demography that ranges from the affluent, to the middle class and to large areas of economically disadvantaged populations whose daily life is a constant struggle. While the traffic congestion in the city and its regions affects all levels of society, increasing vehicle ownership and traffic congestion worsens conditions for the poor, reducing access and mobility to opportunity for employment, education, and access to other civic services and recreation.

The decline in the transport condition is typified by the combination of a collapse in the public bus system, rising car ownership, greater use of motorcycles, and a huge dependency on Rickshaws and Qingqis to shoulder the burden of public transport. Para-transit fares exceed regulated bus fares, with Rickshaws operating on negotiated fares and Qingqis fares ranging from PKR 15-30, impacting on the cost of travel and contributing to the suppression of demand – where people reorganize their lives to cope with the situation, or abandon opportunities they may have otherwise taken up.

Middle income earners comprise the largest sector of motorcycles users being a low cost commute option compared to cars and due to the lack of public transport options. Evident in the travel surveys is a strong indication that improvements to public transport would easily win over this sector.

The overall failure of transport in Lahore can be attributed to a failure in urban governance with a bureaucratic and project–centric approach (under an infrastructure led strategy) is

inadequate to meet rising transport challenges. A history of non-materialized projects has culminated in the present situation with ad-hoc planning with little strategy and coordination, and a lack of consensus across political lines.

The overall public transport system in Lahore has been grossly and continually underfunded due to regulated fares that cannot sufficiently recoup sometimes even operating costs. The collapse of public bus operations and the lack of willing investors indicate a general sense that the business is not financially viable. In response to the poor economic prospects of the business there are indicators that operators have in some cases exploited government support to improve their financial condition/ profitability.

The cost of bus operations has been adversely affected by reducing traffic speed, slowing buses, reducing fleet efficiency and fleet productivity, and increasing fuel costs. The increasing price of fuel without commensurate fare increases has also played its part in the demise of the system.

Ultimately, the attitude of private investors is formed through their perception of risk. Where operators carry risk, they cannot manage, there is little prospect of success. Considerable effort has been made to reinvigorate the public bus industry, and presently the LTC aims to structure a subsidy scheme to attract and support bus operations, but unless sustainable business models are developed that address risk, build investor and operator confidence, these initiatives will also fail.

Ultimately a social policy of regulating fares without sufficient compensation will (and has resulted) in financial collapse of the operator, or the delivery of poor services. Such social policy is therefore a poor social outcome. The outcome has been that passengers are either denied a service, or pay much higher fares for Para-transit modes.

However, Lahore is not alone in this situation as many worldwide cities (including the world's leading cities) struggle under the challenges of managing city traffic and developing more sustainable and efficient transport systems (and learning how to win over passengers from their private means of travel). Contemporary approaches to public transport institutions are more commercially-oriented, aiming towards business sustainability and built-in incentives to improve system performance and customer services. Where this can be achieved, governments win through improved transport efficiency (reduced costs), cities win by improving production and quality of life, and passengers are provided with affordable and quality travel.

For Lahore, the critical task and central focus should be to improve mobility and accessibility in the city, and by doing so, improve economic opportunities and production; ensure social inclusion for all; and create a city that offers a quality of life to its citizens and

future generations.

3.3.5 Development Strategy

1) Strategic Planning Approach

The transport problems of Lahore City are all-encompassing, requiring a range of synchronized policy approaches and solutions. A strategic planning approach will develop clear and defined (and agreed) objectives aiding the planning process toward desired outcomes. Strategic planning must be underpinned by sound principles to ensure successful outcomes and can serve as a basis for consensus amongst all stakeholders regarding direction and objectives. The following items are listed as the essential underlying planning principles for the city and its transport, which will direct and support the strategic planning framework.

2) City Vision

Firstly, policymakers must envision the future of the city. In a 21st century world, cities face new and different challenges; among them: energy cost and security; pollution and climate change, the necessity to limit carbon emissions and increasing conflict over road space.

Defining a vision requires questioning: “Will Lahore is a city for cars or a city for people?” “Can its rich cultural heritage, its artifacts and its charm survive the onslaught of changes wrought by development and misguided infrastructure development?” “Can its significant tourism potential be realized and safeguarded?”

European cities in facing the same challenges adopt bold urban design and management policies to make car travel more difficult (as a demand control measure) and to encourage, support and promote pedestrian space, cycling and public transport. The cultural attractions, lifestyle and city environment are thus preserved.

3) Focus on Accessibility and Mobility

A policy focus on accessibility and mobility (not just infrastructure for cars) has a multilayered impact. It encourages the improvement of road management and better use of existing infrastructure; promotes public transport (which is more energy efficient and emissions sustainable) and can rebalance the way roads function in the city.

By focusing on the public transport network, access improves, firstly by a person’s proximity to the network and secondly, once on the network, a choice of destinations that can be easily reached. Transport access can also be a strong poverty reduction strategy, by connecting the poor to the economic opportunities in an expanding economy.

4) Create a Balance in Road Use

Worldwide experience shows that traffic congestion may actually never be 'solved', and the logic of building more roads to 'ease' traffic congestion is a highly questionable strategy. Given the growth and demand for personal travel, any increase in road space will be quickly absorbed by more cars. The adage 'more roads equals more cars' is true, and flyovers built to 'solve' congestion will, in many cases, just speed up traffic to the next bottleneck, actually worsening congestion.

Clearly, cities do need basic and adequate roads infrastructure in the transport network, but road widening projects aimed at reducing traffic congestion are likely to be ultimately ineffective and will cause negative impacts on the living environment in the city. It would be preferable for Lahore to concentrate on developing basic roads in needy areas rather than widening roads for more traffic, such as the proposed Canal Bank Road widening project.

The only sustainable strategy is to improve the management and utilization of roads, recognizing that cities are for people, not cars and reclaim space for walking, cycling, and communities to enjoy public space. Efficient transport systems like BRT can absorb demand and improve road capacity allowing cities to be rejuvenated as communities. Improving the quality of public transport can help to make it a "lifestyle choice" reducing the tendency for increasing car use.

Cycling, while often regarded a 'poor man's travel' in developing cities is making a huge comeback in first world cities, where space and conditions are provided for safe cycling. In European cities the mere reduction in city traffic has allowed cycles to mix safely with other traffic on inner city roads. Cycle ways have become a popular and essential part of road development and promotes a healthy a low cost, energy efficient and environmentally friendly transport alternative. Cycle ways are a good supporting measure for public transport and a valid option for all income groups. It also offers low cost mobility to poor sectors of society.

Using road or congestion charging to manage road use is also a mechanism to balance the use of the road, while raising revenue to invest into public transport (the London model). Ultimately, traffic congestion can be regarded as an incentive for motorists to switch to a faster and more efficient public transport system.

Figure 3.3.4 Integrating Public Transport and Redesigning Inner City Road Use - Europe

Source: JICA Study Team

Figure 3.3.5 Restoring City Centres to Create People Friendly City Environment - Europe

Source: JICA Study Team

5) Develop a Clear and Defined Transport and Development Strategy Specific Aims and Objectives Targeted in an Action Plan

Locally, transport policy and planning have typically been the domain of political players, predominantly focused on specific projects, often as ad-hoc responses to varying needs and issues that arise from time to time. Previous master plans and feasibility studies, while being prescriptive in projects and timelines, have not provided sufficient strategic support and guidance as to why and how projects will achieve objectives. In fact, objectives are often not defined, save the objective of building 'something'. Lack of strategic thinking and poorly defined objectives also limits stakeholders in their innovation toward non-traditional approaches and does not enable the critical evaluation of projects; how they meet objectives; which projects to prioritize or synchronize for greater impact.

The lack of strategic framework in master planning often does not allow policymakers to adapt to changes during the plan's effective period (changes caused by national or global financial constraints, specific components of the plan not materializing etc) leaving them uncertain as to what alternative actions to take. Consequently, Master Plans are often have a short shelf life if they are not supported by a sound strategic framework.

One further advantage of establishing a strategic planning framework is that it can be used to develop a first level of consensus and agreement amongst stakeholders – a

common ground of agreement and a point of reference, useful where disagreements surface in more detailed discussions.

6) Improve Institutional Regulation and Management of Transport

Failures in transport are always institutional failures. There are three specific areas where improvements should be made, being:

Firstly, it is the lack of coordination in managing the urban transport function in the city. This is a worldwide issue, as traditionally governments have various unrelated departments managing individual elements of transport within the city. The increase in the size of cities and spreading urban conglomerations (often traversing municipal boundaries), has demonstrated the need for better coordination to manage urban transport (and urban development) as a single function. To achieve this, strategic policy development should be placed under a single policymaking umbrella. There also needs to be a separation of function, with strategic policy development at the highest level, executing agencies at service delivery management level and actual service delivery under contract. This creates proper oversight and accountability and defines clear functional roles, responsibilities and obligations.

Secondly, there is a lack of a system network in the sphere of public transport. A collection of single routes does not make a network. Individual operators collect single fares for single trips and will often work against the network to maximize their own returns. Managing the network as a system is essential, with system wide planning, integrated fares and ticketing (one ticket across the network) and revenue spread across the system to provide equitable levels of service.

Thirdly, the failure of regulation is mainly due to the risk borne by operators (and also there being a very large number of individual operators to manage) where the economic survival instinct of operators is often in conflict (and stronger) than the regulations designed to govern their activities. Management and business models must be designed to assign risk between the parties to where it can be best managed, where the bus agency becomes the system manager (taking business risk and acting a commercial and business-like entity) and bus operators plying buses under a sound and financially viable business model.

7) Develop Viable Business Models to Support and Develop Public Transport

Transport must operate in a commercial and business-like way. Subsidized transport operations are seldom efficient as there is little incentive to improve revenues and increase efficiency. A business model driven by revenue growth (not subsidy) is more likely to identify and develop business opportunities; develop revenue; improve

management; meet the needs of its customers; develop an efficient passenger network (travel time and destination choice); efficiently manage its fleet utilization and costs, and keep fares more affordable.

8) Develop Efficient Public Transport Infrastructure

Travel speed is critical to operate the bus fleet efficiently and keep costs under control. Passengers benefit from faster travel times thereby attracting patronage and increasing revenues. Bus speed directly impact on costs thereby impacting on commercial fare levels and subsidy requirements. The multiple benefits of improving bus speeds are illustrated in Figure 3.3.6.

9) Ensure Sustainable Funding Structures

(i) Funding Public Service Delivery

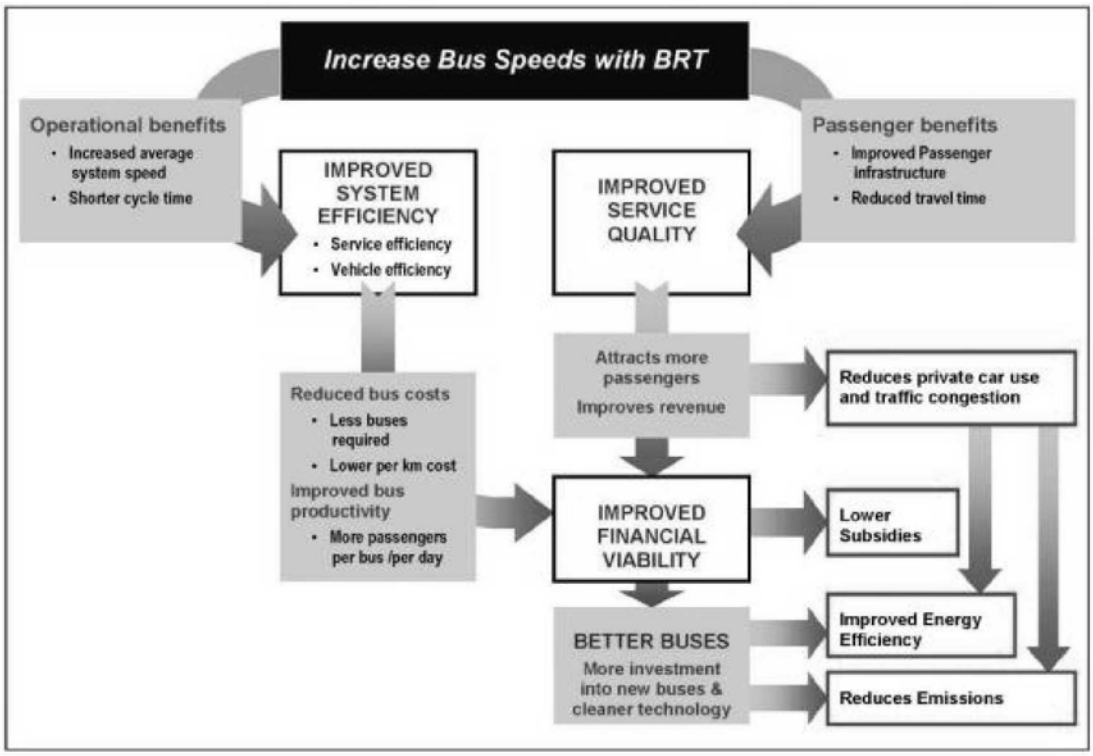
Public transport services should not be designed under the lowest common denominator fare. Adequate system funding and efficiency go hand in hand, where revenue and efficiency is managed on a system wide basis. Centrally managing system revenue has multiple benefits: it separates the system revenue from operators thereby improving revenue control, improving equity across the system (distributing benefits across the system with higher performing routes cross subsidizing poorer routes), and provides the necessary revenue sharing mechanism for an integrated ticketing system. It is the task of the agency to manage fare policy to maximize returns, develop patronage (e.g. discounts for volume users and create market incentives) in the same way a business would manage its competitive pricing policy.

(ii) User Pays Principle

All public service delivery has a cost and someone will pay – the user or the government. Where operators shoulder the burden of an artificially set fare, they will ultimately collapse or provide minimum levels of service typically resorting to illegal or unsafe practices to ensure sufficient returns to survive.

Fares should be set at a commercial fare level – a level that allows full system cost recovery. Where the government invests in improved efficiency like a BRT system, the agency can be expected to be able to reduce or eliminate reliance on subsidy. Should the government choose to provide a user-subsidy it would fully compensate the agency for revenue shortfall.

Figure 3.3.6 Multiple Benefits of Increasing Bus Speeds



Source: JICA Study Team

Similarly, the same argument applies to road users, who presently do not pay for the use of road space (provided free of charge by the government). Road-user charging is a good option to raise funds for road upkeep as well as providing funds that support more sustainable and efficient travel modes such as public transport.

Better financial support of public transport will improve services levels and also serve to influence motorist's behavior. The road user charge can serve as a tool to manage efficient use of road space (the Singapore model) – adjusting toll levels to reduce traffic until road efficiency is reached. However, good public transport system should exist in parallel to road charging so motorists have an option to avoid the user charge.

3.3.6 BRT System as Public Transport Development Strategy

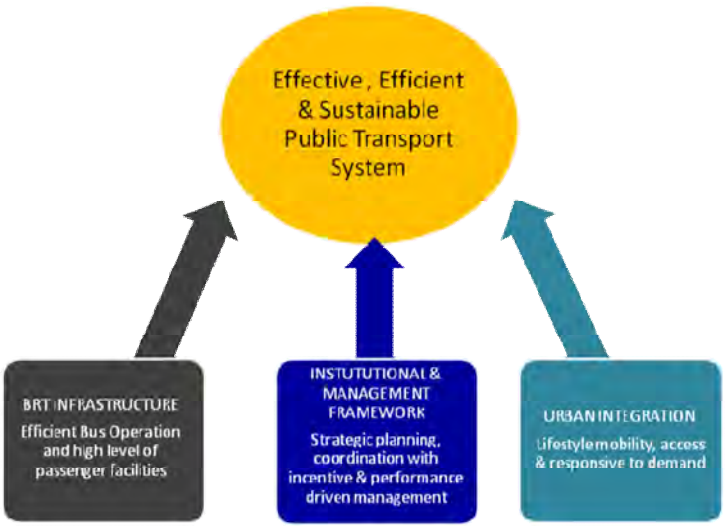
Bus Rapid Transit (BRT) has become increasingly popular as a mass transit mode as it addresses the full range of planning principles outlined above. Its benefits are that it can be well integrated into the city to provide the essential transport network, is designed to offer a high level of operating efficiency which reduces costs, and provides a 'metro' level of passenger service.

BRT is more than just attractive infrastructure making buses efficient. Three essential pillars of support underpin its success as shown in Figure 3.3.7. The institutional and management framework is critical to its success, as is its design into the lifestyle and function of the city. Each BRT must be designed specifically to suit the city in which it

operates and yet maintain its design objectives to guarantee its performance.

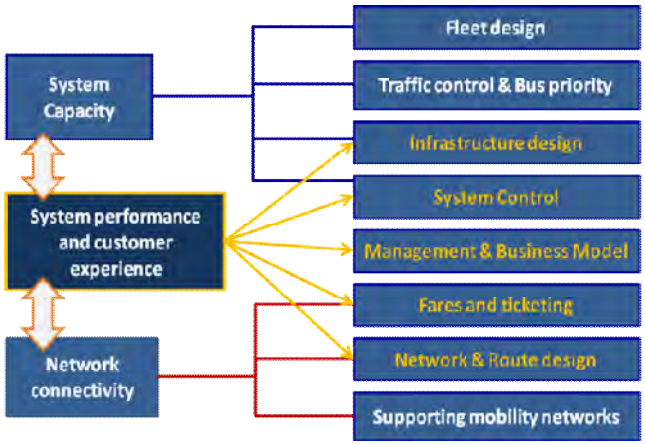
The components of BRT and their connection to service performance, capacity and network connectivity is shown in Figure 3.3.8.

Figure 3.3.7 Supporting Pillars for BRT System



Source: JICA Study Team

Figure 3.3.8 Components of BRT



Source: JICA Study Team

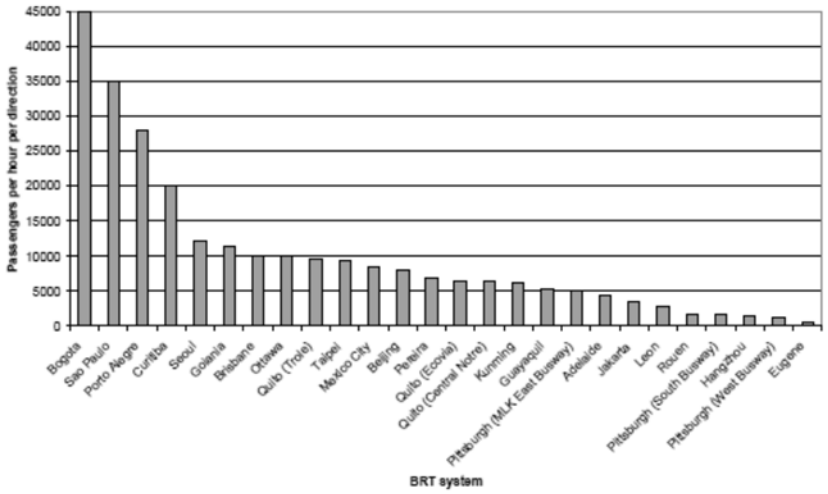
1) BRT Planning Objectives

BRT planning objectives are based on the following criteria:

(i) Ridership

BRT must be designed flexibly to manage a low to high level of ridership on high demand corridors. BRTs in the world are designed to match a wide range of transport demand as shown in the Figure 3.3.9. Given the road and travel demand situation in Lahore all major arterial bus routes should operate as a BRT in order to achieve operating efficiency sufficient to support their viability.

Figure 3.3.9 Actual Peak Ridership of Various BRT System

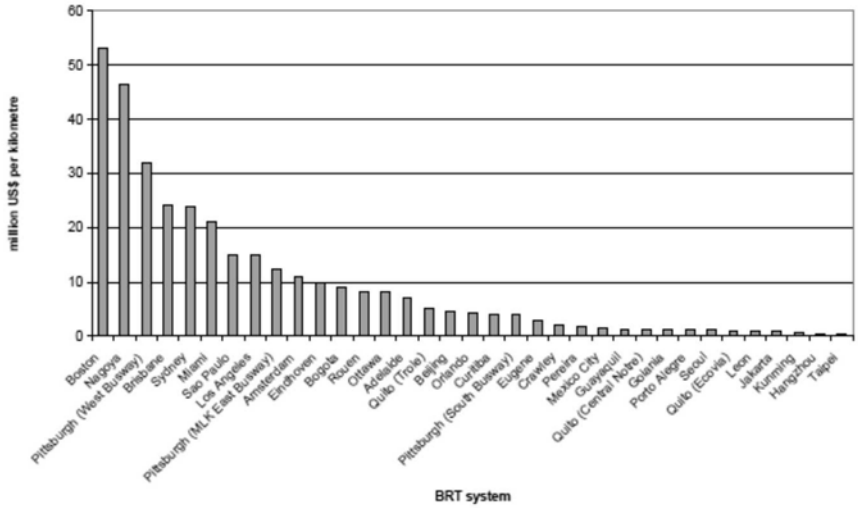


Source: "Bus Rapid Transit Systems – a comparative assessment", David A. Hensher, and Thomas F. Golob, University of Sydney

(ii) Capital Cost Effectiveness

Major corridors in Lahore are sufficiently wide enough to accommodate BRT so there is little apparent requirement to widen road or develop 'right of ways'. Where minor inner city roads need to accommodate a BRT, alternative road use can be considered such as one way traffic (or one way BRT loop service) or converting the street to a transit corridor and removing cars altogether. Figure 3.3.10 shows total infrastructure cost of selected BRT systems around of the world. The cost changes vary from USD 0.35 to 53.2 million per km depending on the design requirements such as station quality, modal exchange facility at terminals and separation from other road traffic.

Figure 3.3.10 Total BRT Infrastructure Cost (per km)



Source: "Bus Rapid Transit Systems – a comparative assessment", David A. Hensher, and Thomas F. Golob, University of Sydney

(iii) Operating Cost Efficiency

A high level of service quality and frequency improves both passenger services and fleet efficiency. The BRT network improves transfer opportunities and reduces the overall number of bus routes that would be necessary in a traditional bus route network.

(iv) Urban and Economic Development

BRT due to its presence as an established transport infrastructure will support city development along the corridor and vice versa (development will support BRT). More compact development and increasing land values along a BRT system will stimulate more efficient travel patterns.

(v) Accessibility Improvements

High quality passenger infrastructure, a strong corridor presence and good connectivity across the network improves the reach and accessibility of BRT across the city and into suburban areas, greatly improving access and mobility.

2) BRT Design Objectives

Identifying clear objectives is a good starting point for designing a suitable system. The following design objectives will guide the planning process:

- To design a system with a mass transit image that offers a high standard of service.
- Give BRT a clear priority over other traffic and be well integrated into the city landscape to make it the transport 'lifeblood' of the city and deliver a balanced use of road space resource.
- Use BRT as an opportunity to maximize corridor capacity while reclaiming space for NMT (cycling) and pedestrians.
- Develop a full network of trunk, intermediate and feeder routes for maximum access and connectivity – a few kilometers of high technology will not deliver a transport solution for the city. The inaugural project should consist of two intersecting lines.
- Use of advanced e-ticketing technology and integrated fares across the network to enable passenger transfers at no extra cost.
- Use advanced technology for bus control in order to develop high reliability, punctuality, convenience, and safety.
- Make BRT financially sustainable and avoid where possible, dependence on government subsidy.
- Improve bus system management with a sustainable business model.
- It must be environmentally-friendly in respect of emissions, energy use, and urban

infrastructure impacts.

- It must use a level of technology compatible to the city, mindful of maintenance skills required and where possible enhance skills development and support local industry.
- The system should be able to cater for future growth in capacity and network coverage with a measure of flexibility to adjust to changes in demand that may occur over time.

Table 3.3.9 shows characteristics of some Asian BRTs. These examples clearly show that there is no fixed concept and BRT and Lahore can develop its own BRT system if proper planning process is followed.

Table 3.3.9 Characteristics of Selected Asian BRT Systems

Characteristics	Jakarta (1st Line)	Seoul (Median Bus Lane)	Beijing (Southern Axis Line 1)
Running Way	12.9 km fully segregated median bus-way from Blok M to Kota.	37.2 km median bus lane colored but not physically segregated.	16 km physically segregated except for a part (2 km).
Station	Elevated platform connected to sidewalk by pedestrian bridges.	Shelters installed on medians.	Stops installed on medians connected to sidewalk by cross-road or pedestrian bridge.
Vehicle	Air-conditioned 56 buses as per Euro II.	Low-floor buses, CNG buses and articulated buses.	15 CNG articulated buses, 40 BRT buses and 50 regular buses.
Service	Headway of 2-3 minutes during peak and 3-4 minutes during off-peak period 5:00-22:00.	Headway 3-5 minutes during peak hours and 7.6 minutes on average.	2-3 minutes.
Route Structure	One dedicated at-grade lane.	Divided into trunk lines and feeder lines. Buses color-coded and numbered by line.	One dedicated at-grade lane.
Fare Collection	Contactless fare card system in advance at stations. Flat fare of 30 cents per ride. Discounted fare applied by time of day.	IC card. Flat fare of 85 cents per trip. Transfer discount applied.	Fare collected manually at bus stops. Flat fare of 25 cents.
ITS	On-board variable message sign. Announcement of next station in Indonesian and English.	At bus stops, passengers are informed of arrival time of next bus.	Next stop announcement system.
Integration with Other Modes	None.	Transfer information on IC card.	None.
Operating body	TransJakarta BP, a publicly managed company.	Private company with public intervention.	A state-owned BRT company with private but subsidized Beijing General Bus Company

Source: Compiled by JICA Study Team based on "Analysis of Policy Processes to Introduce BRT Systems in Asian Cities from the Perspective of Lesson-Drawing", Naoko Matsumoto, Institute for Global Environmental Strategies

3) Sustainable Plan for BRT System

(i) Management Structure for BRT System

Separating the areas of policymaking, management and operation into three clear hierarchal levels, can be achieved through the following distinct functions:

- Policy, regulation and coordination level - consisting of representatives of all key stakeholders, being the departments and agencies, responsible for strategic urban policy; regulation and coordination of urban transport.
- Management level – responsible for bus system management; customer service delivery and central ticketing and revenue collection, and operating as a commercial business enterprise.
- Operation level – managed under a service delivery contract; a performance-based contract fully funded and responsible for delivering bus services on per km basis.

In addition, the US Transportation Research Board paper "Bus Rapid Transit" (2003) stresses the importance of the support from local community to implement a BRT project successfully.

(ii) BRT Management Organization

The proposed Transport Management Board (TMB), Punjab Urban Transportation Planning and Engineering Institute (PUTPEI), Lahore Transport Development Company (LTDC) and Lahore Urban Transport Advisory Council, a further expanded concept from the previously proposed Urban Transport Authority, will improve coordination through high level consensus and develop a strategic urban transport policy to guide implementing organizations in their tactical planning and business operations. Urban development must also be included in strategic planning. The advantage of such a body is that it can develop a shared vision for the city; provide an exchange of ideas and perspectives, and reach a consensus in decision-making for which it can assign responsibility and budgets. It can also recommend major policy direction to the government.

The LTDC will have a Board of Management (TMB) comprising all relevant stakeholders (including heads of implementing agencies and divisions of RTDC) who jointly develop an integrated Strategic Urban Transport Policy. It manages and monitors strategic policy implementation through the line agencies (who are all represented at Board level) and can make adjustments as necessary to adapt to changing circumstances. It has a secretariat and a research and planning section to provide support. It would meet monthly, bi-monthly or as appropriate.

(iii) The Lahore Transport Company (LTC)

The Lahore Transport Company, which is proposed to be merged into PUTPEI and LTDC, would be commissioned to operate as the BRT management company and manage the expanded system including intermediate and feeder bus routes. The LTC would operate in a commercial and business-like fashion focusing on business performance, to win

customers, develop revenues, and manage costs efficiently. The business risk of the system will be borne by LTC.

With a BRT system, reducing or eliminating subsidy is achievable, as BRT is highly efficient and able to carry large numbers of passengers. The government would subsidize social fare discounts (where it sets a social fare level below the commercial cost of operation) as a 'user subsidy' and phase out subsidy for operating losses.

Managing the bus operator through a performance-based contract gives the LTC a strong hand to control quality and performance issues (enforcing penalties for performance failures) but also gives operators a viable and profitable contract to operate.

The Bus Operating Contracts are paid on per kilometer formula that covers operational cost and a return in investment. It ensures bus operations are properly funded to maintain the fleet in good order, to provide trained and skillful drivers and meet the service specifications and standards as required under the contract.

Figure 3.3.11 Example of BRT (TransMillenio, Bogota, Colombia)

The TransMillenio BRT management company in Bogota operates with socially affordable fares and free of government subsidy, relying 100% on revenue generated from the system

Source: JICA Study Team

The specific responsibilities of the LTC would be to:

- Plan and manage the system network
- Manage the bus operator contracts
- Centrally collect revenue
- Manage the integrated fare system
- Manage the BRT control centre
- Manage information and marketing.

(iv) Bus Operating Companies

The kilometer-based contract for bus operating companies provides a sound investment framework to generate investor confidence and fund bus operations adequately. It has to support the required service standard and quality standards stipulated under the contract as well as maintain the fleet in good order, and provide trained and skilful drivers. Contracted payments for kilometers of services provided removes the revenue risk for

operators but also gives the LTC a strong mechanism of control over quality and performance.

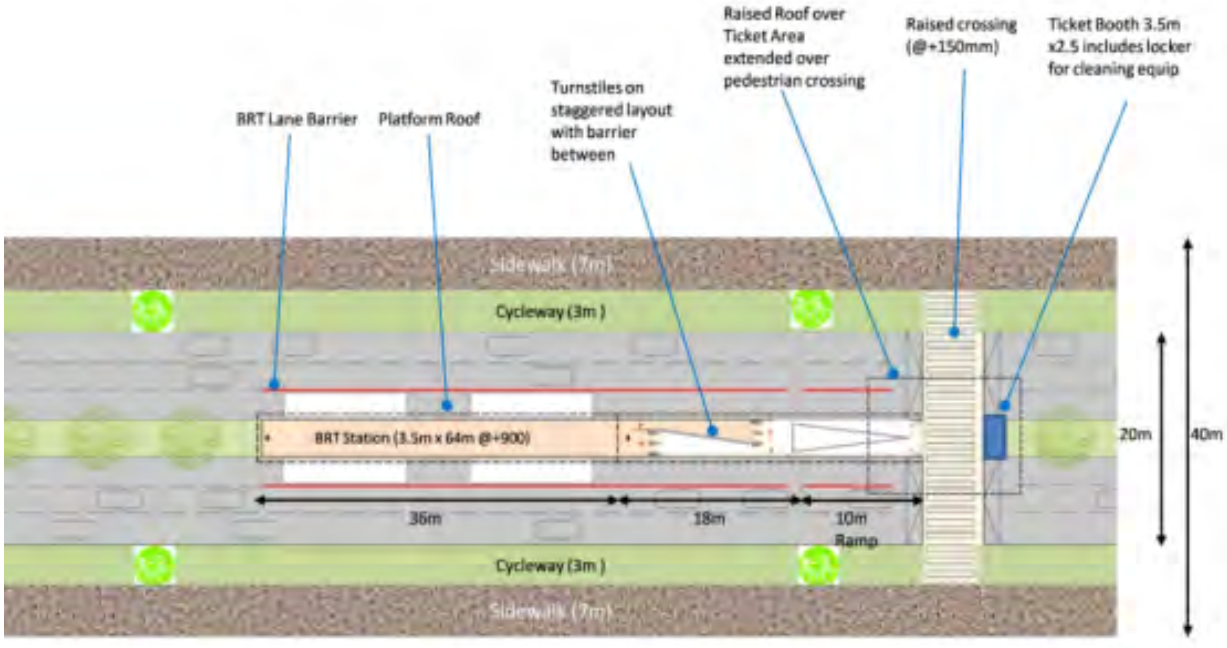
4) BRT Design

(i) Bus-way Construction

Median bus-ways offer the advantage of separating bus traffic from curbside conflicts which will improve traffic flow for both cars and buses. An added advantage is that it allows passengers to transfer between services on the same platform without crossing the road. Median bus stations also consolidate all ticketing and station platform activity in one central location, avoiding the cost of operating two platforms and ticket booths. Median bus stations also remove busy station activity from the footpath areas and do not incur any extra road crossings for passengers.

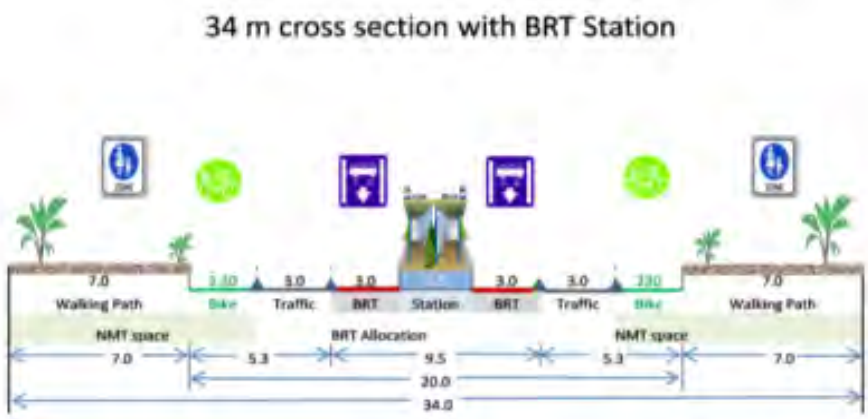
However, pedestrian crossings across the roadways need to be safely managed using signaling and raised crossing sections which can also act to slow traffic and create driver awareness of a shared pedestrian zone. Typical road cross sections for BRT are shown in the following Figures 3.3.12 to 3.3.15.

Figure 3.3.12 Plan View of BRT Station



Source: JICA Study Team

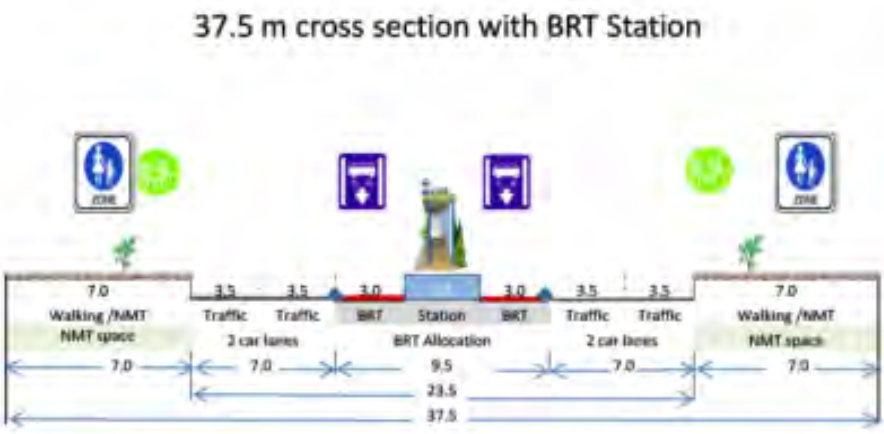
Figure 3.3.13 Inner City Narrow Corridor



Station	YES
Cross section	34 metres
Cycleway	Separate
Mixed traffic lanes	1 in each direction

Source: JICA Study Team

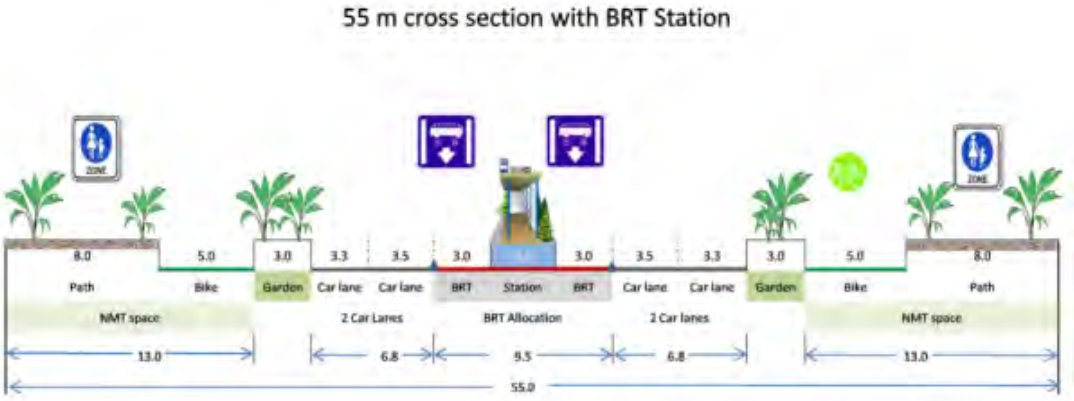
Figure 3.3.14 Median Station with 2 Traffic Lanes



Station	YES
Cross section	37.5 metres
Cycleway	No (could share with sidewalk)
Mixed traffic lanes	2 in each direction

Source: JICA Study Team

Figure 3.3.15 55m Right of Way at Station Location with Cycle Paths



Station	YES
Cross section	55 metres
Cycleway	Separate
Mixed traffic lanes	2 in each direction

Source: JICA Study Team

(ii) BRT Stations

BRT stations are more than 'bus stops'; they are an important infrastructure element that influences customer service and amenity. They must also present an attractive and modern appearance and use high quality building materials to ensure a long life and that standards are maintained with little maintenance required.

Facilities such as ticketing equipment, ticket sales counter, disabled access, clear signage and beautification are all important elements that need skilled design.

BRT station design suitable for Lahore should include the following:

- Cost effective with clean design lines
- Closed station platforms minimum 3.5 meter wide with prepaid ticketing
- Varying length and configuration to manage fleet density
- Integrated into urban space with signalized level crossings
- Attractive image and strong system branding
- Quality built for easy maintenance and long life.

(iii) Pre-board Ticketing and Customer Service

Pre-board ticketing is used at bus stations and passengers pass through a turnstile on entry and/ or at exits. A ticketing sales counter is located at every station for passengers wishing to purchase cards or recharge value on their cards. Ticket vending machines can also be placed at high volume stations. Security staff assists on station platform and ensure rules of travel are enforced.

(iv) Mass Transit Image

System branding and a consistent brand image are important to make the system highly recognizable and attractive. Good information signage and promotional material will make the system easier to use and convince passengers of the system benefits.

(v) Bus and System Control

A defining feature of BRT is the central control of the system in real time to monitor service schedules and operations. GPS vehicle tracking provides management and passenger information. A typical central system is illustrated in Figure 3.3.16.

The Control Centre can manage service disruptions quickly and attend to any security or safety risk events. Constant communication with each bus and schedules managed in real time ensure reliability of services. GPS tracking of buses at the Control Centre also provides automatic 'next bus' information to passengers at stations (suitable where services are less frequent). This makes services more predictable and reliable, removing the uncertainty often associated with public transport use.

BRT systems can use 'green light' signal priority to minimize traffic disruption and ensure schedule compliance. By using GPS tracking, the system 'knows' where the bus is, allowing bus movements to be synchronized with green light phases to provide bus priority with less impact on cross traffic.

Figure 3.3.16 Bus and System Control

Control Centre Brisbane

Graphic interface showing bus locations

Source: JICA Study Team

5) Integrated Ticketing and Seamless Transfers

To create a full public transport network requires integration of feeder buses with the BRT and a compatible ticketing system across the network, as shown in Figure 3.3.17.

Intermediate buses are secondary routes designed to operate off the BRT on suburban routes where they can operate kerbside boarding and alighting the same as a standard bus. However upon reaching the BRT they can dock at the BRT platform (on the paid side

of the platform) using a level boarding doorway on the right hand side of the bus. This allows a seamless and efficient 'on- platform' transfer from feeder buses. These intermediate buses however must be provided with varying bus priority treatments even though they will often operate in mixed traffic. As these buses are BRT compatible, there is a flexibility offered to allow the operation of these buses on the BRT track during off-peak or where a short distance operation on the BRT is required.

Ticketing is integrated across the whole BRT fleet, with passengers swiping the IC card on the intermediate and being able to connect to the main BRT service without needing to re-enter the system via the ticket gate. Passengers can also transfer between routes at any BRT station where the routes overlap and do not incur a penalty cost by transferring across services.

Figure 3.3.17 Integrated Ticketing and Seamless Transfers

Ticketing turnstiles at entry exit to a prepaid platform area (Bangkok BRT)

Smart card ticketing at turnstiles records each trip at allows free transfer across the network

Source: JICA Study Team

3.4 Traffic Management

3.4.1 Present Condition and Problems

1) Driving Behavior

(i) Driver Education

There are no proper driver training schools/ institutes exist in Lahore. There are many small training schools established locally focused on limited training and high profitability and neglect the basic principles of traffic safety and travel behavior on the road.

Road Traffic safety and travel behavior is not part of syllabus in schools and colleges. This results in complete unawareness of road safety. Traffic police is trying on its own to give talks in schools and colleges, and also conducting traffic safety and driver behavior seminars to limited extent. These efforts are not sufficient at all to create proper travel behavior and road safety awareness in general public.

Traffic police has started Rasta (Road and Traffic Safety Awareness) website. This is a good step toward creating public awareness but this couldn't be productive if it is not supported by educational institutions which may lack computing facilities.

(ii) Licensing System

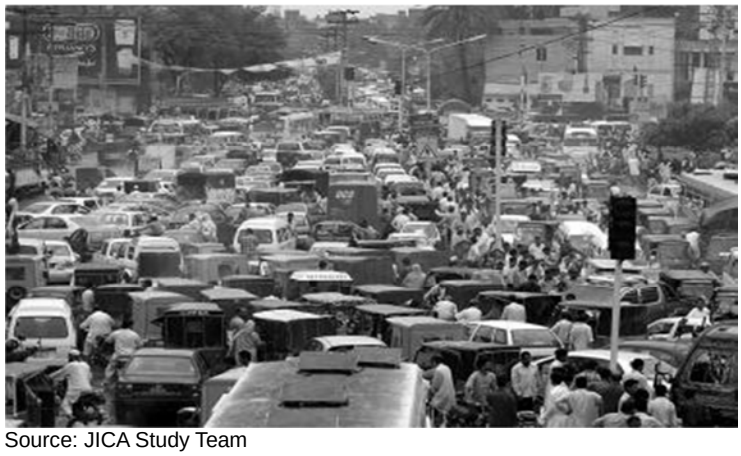
Traffic Police of Lahore is responsible for issuing driving licenses for all type of vehicles. New applicant has to get learner license valid for 3 months. After that there is a driving test in Traffic Police training school of the candidate. Applicant has to get training in that period and learn the Traffic Codes.

Traffic police don't refer any training school due to absence of such facilities. This results in poor training of drivers and complete lack of understanding of complex traffic situation of Lahore. Applicants learn driving on their own, from their fellows or relatives; who themselves had received no proper training thus can't teach except how to drive the vehicle.

(iii) Driver Behavior

Due to lack of proper training of drivers, results in strange driver behavior on roads which contributes to traffic congestion, traffic accidents, and at times a total gridlock of some junctions as shown in Figure 3.4.1.

Figure 3.4.1 Traffic Gridlock at Qartaba Chowk, Ferozepur Road



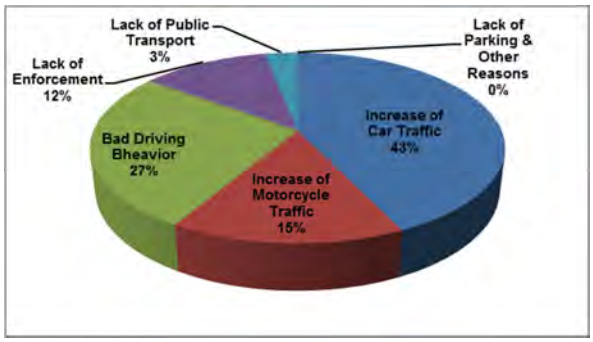
Source: JICA Study Team

Drivers generally do not have sense of traffic and safety; commonly everyone tries to drive in the fast lane including Rickshaw, Qingqi, Car, Motorcycle, Bus. This results in clogging of fast lane, and then drivers shift to middle or slow lanes which happen to be little use, this result in violation, i.e. overtaking from the left side or the lane of right of way of pedestrians, cyclists, and accidents in most cases.

Weaving behavior of drivers on main arteries results in lane changes from fast to slow and slow to fast at all time. This can be observed along Canal Bank Road from Ferozepur Road underpass to Jail Road underpass during peak periods.

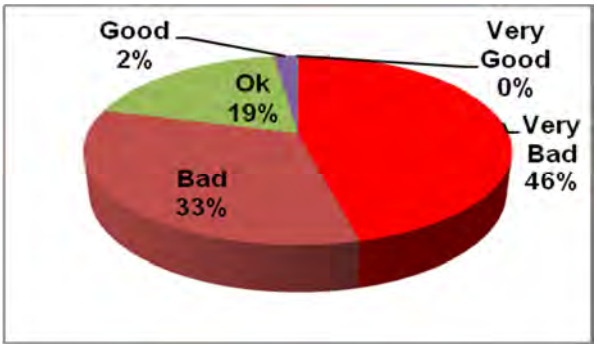
Drivers do not wait at junctions for their signal phase and often cross the stop line, even come in the middle of junctions along major arteries like Mall Road, Jail Road, G.T. Road, Ferozepur Road, Gulberg Main Boulevard, Airport Road and in some time in and around the walled city area.

Figure 3.4.2 Public Opinion of Traffic Congestion Reasons; Bad Traffic Situation (27%) and Lack of Enforcement (12%)



Source: LUTMP HIS

Figure 3.4.3 Public Opinion of Driving Behavior of Motorcyclists



Source: LUTMP HIS

2) Traffic Enforcement

(i) Institutional Set-up

Traffic enforcement is managed by a mixture of institutions that have varying degree of responsibility for enforcing traffic rules and regulations in Lahore. Traffic police is controlling traffic violations, encroachment and parking up to limited extent. This is done in coordination with TEPA and CDGL. CDGL controls illegal parking and encroachment. LTC is responsible for removing illegal operation of Qingqi, Wagons from notified bus routes and for the regulation of bus, wagon route permits. RTA and PTA control permits for inter-city bus operators, bus stands, and truck operators and stands.

Traffic police staff is about 3,700 which consist of 3,030 traffic wardens. Traffic enforcement is not fully effective in the city due to additional duties of traffic police for traffic operation, management of day to day circulation plans, VIP movement's control, and special management plans for riots, protests. 12% people responded in LUTMP HIS that lack of traffic enforcement is the main cause of traffic congestion in the Study Area.

Traffic signal operation of major signalized junctions is in very poor condition, signal timing is not based on traffic situation; which results in manual operation of traffic in peak hours by Traffic Wardens. These above mentioned factors are severely minimizing the effectiveness of such a large force of traffic wardens in the city as they are involved in doing functions of TEPA. CDGL do not have enough administrative capacity to effectively control the illegal parking and encroachment in down town area and along other major roads in Lahore.

LTC has constituted a force of traffic control wardens to control illegal operation along bus routes by Wagons and Qingqis; but it is ineffective due to shortage of buses on these routes, results in passengers using available mode (wagon) operating on these routes.

RTA and PTA are issuing route permits without any proper record and compliance of regulation. In any case, many illegal bus and truck operators ply on almost all inter-city routes, and have also established illegal bus and truck stands throughout the city, especially in downtown areas of Ravi and Samanabad Towns.

(ii) Introduction of Intelligent Transport System (ITS)

Automatic Number Plate Recognition (ANPR) system could not be implemented in Lahore due to presence of numerous type and size of vehicle registration number plates. Traffic Police has no control over the use of standard number plate issued by Excise and Taxation (E&T) Department. Everybody is using different design, position and even color for registration number plates. These cannot be read through sophisticated ANPR system as shown in Figure 3.4.4.

Although ITS system is expected to be effective in the current traffic situation of Lahore, the problem of non-standardized number plate has become one of the serious obstacles to its implementation such as the use of ITS technologies for Electronic Toll Collection (ETC).

Figure 3.4.4 Non-Standard Number Plates

Source: JICA Study Team

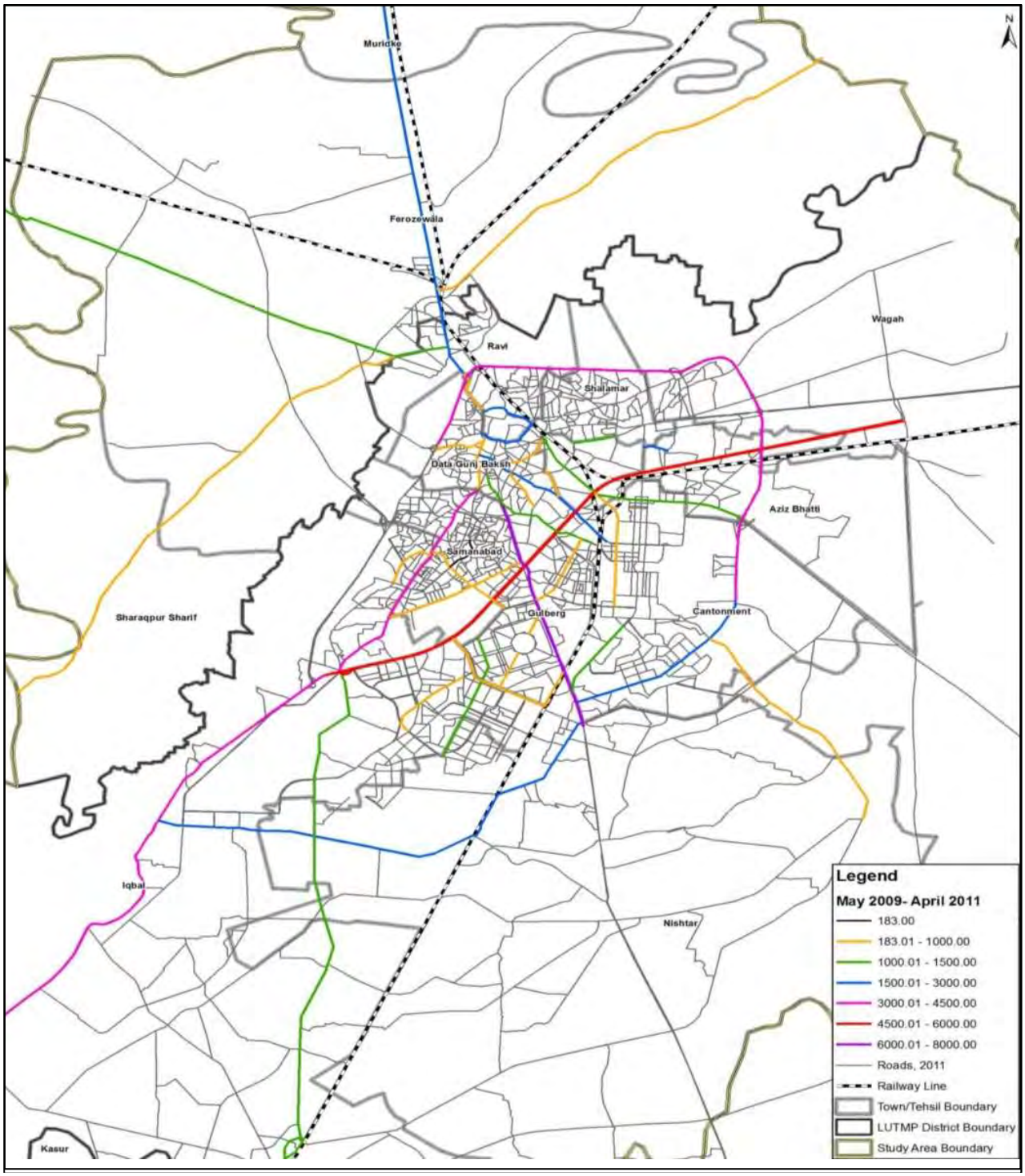
3) Traffic Safety

Traffic safety is the most overlooked traffic management issue of Lahore, there is no such previous study addressing the issue of traffic safety comprehensively in relation to the existing traffic condition. This seriously needs to be addressed under the current circumstances as most authorities/ agencies are moving on the paradigm of widening of all possible road facilities up to the maximum use of existing right of way. This in turn encourages the car and motorcycle drivers to over-speed causing a serious safety hazard. Road accident data for the last two years from May, 2009 to April, 2011 clearly shows the increase in traffic accidents on Ferozepur, Multan, G.T., Canal Bank, and Lahore Ring Roads as shown in Figure 3.4.5.

Problem of road safety in Lahore has been worsening largely due to lack of proper diagnostics. No research has been conducted in the past, and traffic safety issue cannot be addressed properly until the real contributing factor to this problem has been identified.

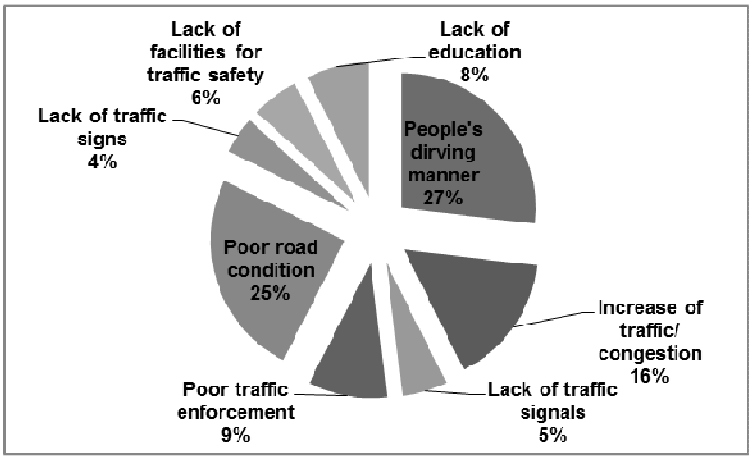
When asked about the factors contributing to traffic safety issues in the Study Area people driving behavior, and poor road junction conditions were the major factors identified by public as illustrated in Figure 3.4.6.

Figure 3.4.5 Total Number of Accidents – 2009 to 2011



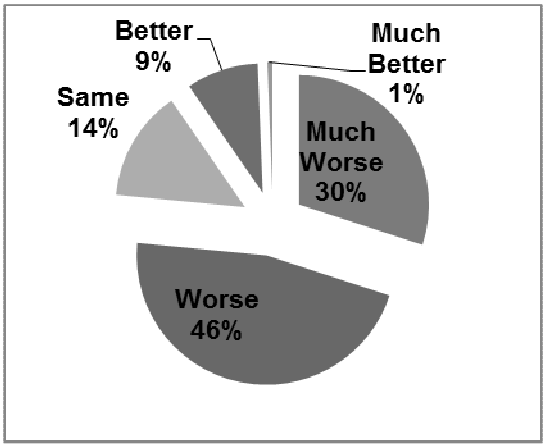
Source: Lahore Emergency Services (Rescue 1122)

Figure 3.4.6 Factors Contributing to Traffic Safety



Source: LUTMP HIS

Figure 3.4.7 Traffic Safety Situation Compared to 5 Years Ago



Source: LUTMP HIS

20% of the households responded, have been involved in traffic accidents in the Study Area in last five years; 60% of them suffered slightly injured 29% seriously, and 11% minor or no injury. Whereas, 76% of the respondents replied that traffic safety situation has become much worse or worse in last 5 years. This shows effective counter measures are necessary as shown in Figure 3.4.7.

(i) Traffic Mix

Heterogeneous traffic has unique safety issues in Lahore. These are mainly due to interaction between the disparity in vehicle speeds and sizes. The mix of traffic is the largest determinant of traffic fatalities. Effect of uncontrolled traffic mix is shown in Figure 3.4.8. Proportion of non-motorized traffic (NMT) and motorized vehicles in a traffic mix resulted in increased number of NMTs fatalities.

Figure 3.4.8 Traffic Chaos Traffic Mix near Data Darbar

Source: JICA Study Team

Figure 3.4.9 Pedestrians Road Crossing – At Their Own Risk

Source: JICA Study Team

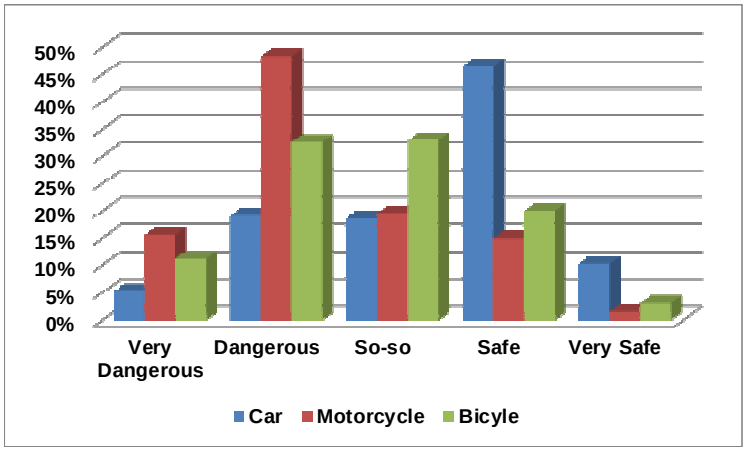
Exposed vulnerable road users such as NMTs are in proximity to higher speeds unavoidably causes conflicts and road accidents. Vulnerable pedestrians in Qartaba Chowk are shown in Figure 3.4.9. It is confirmed by Lahore Emergency Service record that majority of fatalities and injuries are related to pedestrians, cyclists, and motorbike riders.

The composition of higher-speed vehicles in the traffic mix can cause drastic differences in the fatality rates. Another significant determinant for heterogeneous traffic fatalities is street width and severance caused by barriers in the divided carriageways. Due to loose or no lane discipline smaller slower vehicles are at high risk for collisions. One of the unnoticed causes of major fatalities in Lahore is the poor manner of using public transport services, such as buses are crowded, and when one is involved in a collision, a large number of people are at risk. This is especially the case for those hanging from the footboards of the bus doorways, and sitting on the bus roof top e.g. Recently an accident took place on Canal Bank Road underpass killing five children sitting on top of the bus.

Local illegal public transport vehicles like Qingqis are the most vulnerable vehicles prone to accident due to its highly unsafe design and tendency to topple over at speed more than 30kph on sharp turns or even when breaking.

People were asked about the traffic safety in LUTMP HIS survey; how unsafe they feel when using car, motorcycle or bicycle about 50% responded motorcycle and 35% bicycle are dangerous to use in existing traffic condition. Car is regarded as safe to use as shown in Figure 3.4.10.

Figure 3.4.10 Traffic Safety in Different Private Vehicles



Source: LUTMP HIS

(ii) Vehicle Inspection and Certification System

Transport Department, GoPb is responsible for vehicle inspection, and issuing fitness

certificates to inter-city and intra city public transport and goods vehicles. Motor vehicle examiners (MVO) are responsible for each vehicle inspection for its safe operational condition, physical condition of bus overall, safety, sitting environment and comfort for passengers etc. MVOs must have diploma in mechanical engineering and field experience of vehicle maintenance and inspection to be eligible for this post.

However, these MVOs do not have any vehicle inspection workshop equipped with testing machinery and proper mechanism of checking testing of all components related to vehicles road-worthiness. Permits and fitness certificates are commonly issued on visual inspection or no inspection, and further there is no enforcement mechanism in the field to check, and verify the vehicle fitness certificates.

Further, there is no legal requirement for yearly inspection of private vehicles including Qingqi. This is one of the major reasons of environmental pollution like smoke and noise, and also contributes to traffic accidents. Survey shows in Pakistan, about 3.5% of all vehicles are allegedly involved in traffic accidents due to mechanical failures corresponding figure for the developing countries is 2.5%.

(iii) Roadway Design and Traffic Control Devices

There is a strong association between road traffic accident rates, road design, and its surface condition. Well-designed roads promote safety and reduce accident. It is clear from the road accident records of Lahore that wider roads are associated with higher rate of accidents than narrower ones.

Roads in Lahore are not designed for all weather conditions, as in the rainy season almost all major roads are flooded due to poor implementation of geometric design based on AASHTO standards without taking into account the rain water drainage under local conditions as shown in Figure 3.4.11.

Figure 3.4.11 No Properly Designed Drainage System Results in Submerging of Roads

Source: JICA Study Team

There is no roadway geometric design standards exists in Punjab, and most of the designs are prepared on ad-hoc basis or perceptions. Major highway design firms in Lahore are following American Standards (AASHTO) for design of any urban or rural street, or road in Lahore. These standards are designed for the homogeneous traffic; like they do not consider the impact of strange

traffic mix of Rickshaw, Qingqi, Motorcycles, Carts and animal carts and poor driving behavior in developing countries like Pakistan. When these standards are directly applied without due consideration of existing traffic situation, this would result in severe traffic safety issues at junctions and road alike.

JICA 1991 study proposed underpasses on canal road which were implemented by GoPb through LDA, TEPA; who unfortunately lacked the technical capacity to design such structures. Underpasses were designed of less than the standard height, and buses and trucks with a height of more than 3.6m cannot pass as shown in Figure 3.4.12, this resulted in many severe accidents in the past. Jail road underpass is shown in Figure 3.4.13 showing scratches to roof due to several accidents.

Figure 3.4.12 Low Height Underpass with 3.6m Vertical Clearance

Source: JICA Study Team

Figure 3.4.13 Jail Road Underpass – Scratches on Underpass Ceiling

Source: JICA Study Team

Secondly, the intercity or primary roads like Multan Road, and Ferozepur Road suffer the highest accident rate, have capacity far in excess of the traffic demand which results in free flow condition and high speed driving. This encourages un-disciplined behavior with vehicle wandering all over the carriageway.

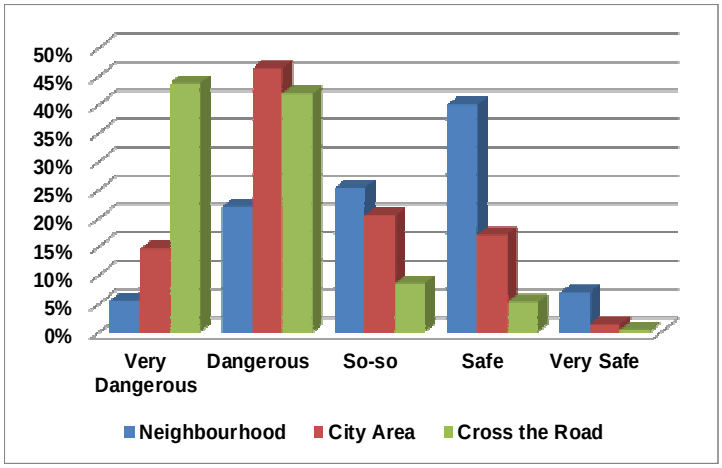
A research has been carried out in Rawalpindi-Islamabad; where selected locations were well engineered, with proper road marking, and controlled by a very conspicuously placed stop sign. The 90-97% of the drivers of various types of vehicles did not stop or even slow down. When interviewed such drivers why they didn't slow down, about 85% responded there was no stop sign installed at the intersection. This can be explained by the fact that the road markings and signs are primarily needed to guide all drivers in the traffic stream to their destination safely. For those familiar with their routes, these signs do not give any additional information.

Traffic control devices standard has been developed by The Urban Unit, GoPb. This manual lacks local context, and more or less is the copy of MUTCD British Standards which are not directly applicable to local complex traffic. TEPA is responsible for planning and installation of traffic control devices in Lahore. They have no technical capacity to understand or develop the installation guidelines, and relying on the private traffic signs manufactures for signage and their installation; who themselves do not have technical capacity to carry out such tasks and do not even bother to consult the manual prepared by The Urban Unit.

(iv) Road User Behavior

Pedestrians are the most vulnerable road users and do not have any awareness how to cross the road safely. Pedestrian crossings are poorly laid out or totally absent. 90% of people responded that crossing the roads is very dangerous or dangerous as shown in Figure 3.4.14. In addition lack of footpaths forces the pedestrian to use the road space for walking which results in further increase in causalities.

Figure 3.4.14
Traffic Safety Level in the Study Area



Source: LUTMP HIS

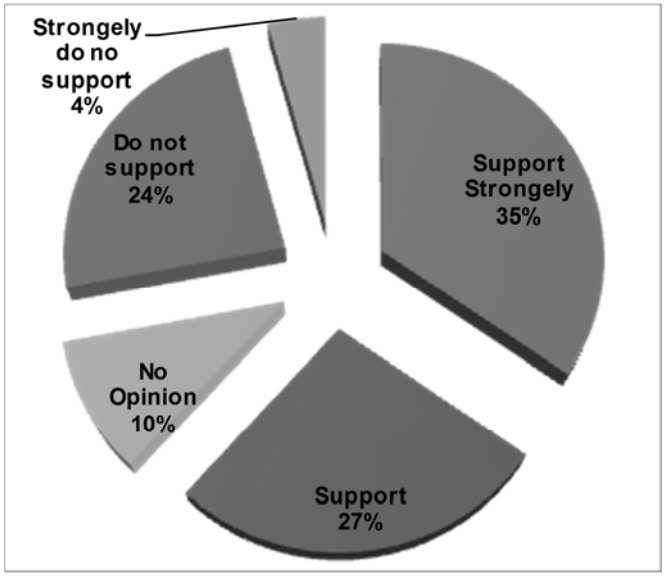
(v) Auto-Rickshaw and Qingqi

It is most common in Lahore that young children below 18 years age are driving Qingqis and Rickshaws mostly illegally without license on self-defined routes. This is also a major cause of accidents due to poor driving standards. There is total lack of enforcement mechanism to curb such illegal drivers. 62% of the people supported removal of this Qingqi from the existing transport system as the transport improvement in the Study Area as reported in the Figure 3.4.15.

Motorcycle has 54% of share in all type of vehicular traffic in the Study Area, and most commonly used by males of all age groups. The driving problem is the same young

generation below 18 years without any training or license ride motorcycles without any fear of accidents or awareness of traffic laws. They are often involved in traffic accidents sometimes fatal due to their own poor driving/ behavior.

Figure 3.4.15 Public Opinion on Removal of Qingqi



Source: LUTMP HIS

(vi) Data Records and Accident Black Spot Analysis

Traffic accidents record keeping is not clearly the responsibility of anyone organization or institution. Mostly, serious accidents are reported to nearby police station; which have no technical training or capacity to analyze the cause or the reason of traffic accident and other conditions. Police take notes of some basic information like type of vehicle, registration number, and driver's credentials for prosecution. Sometimes, information is based on crowd comments on accidents. Traffic police do not have any record keeping mechanism for use of accident data analysis.

Emergency Service (1122) also has manual record keeping process involving type of accident like fatal or injury and vehicles involved etc. as their main objective is to give first aid and provide additional medical help to patient or transport of the injured to hospital as priority.

Developing traffic accidents record, and to do accident black spot analysis for improving accident prone sites through better traffic management is in the domain of TEPA in coordination with Traffic Police and Emergency Services. However, TEPA has no capacity to conduct such analysis.

Emergency Service (1122) collects the accident data for their own specific purposes. This data can be effectively utilized by improving the capacity of 1122 for data collection and establish a comprehensive database. This database could be further investigated by

Traffic engineers or traffic safety experts in TEPA to improve the safety at accident sites.

4) Road Junctions and Traffic Signal Operation

Road junctions are provided as interchange facility between roads at-grade. Various traffic movements result in full or partial conflicts between traffic flow and pedestrians crossings at junctions.

Therefore, junctions are designed to remove or minimize the impact of vehicle-vehicle and vehicle-pedestrian conflicts. Conflict between vehicle and pedestrian is controlled by distributing the junction time and space to them. Proportionate time allocated to each movement should be based on vehicle/ capacity ratio, and delay analysis of each movement. Different techniques like through traffic signals (pre-timed, semi actuated, fully actuated), roundabouts, and priority junctions are designed. Developed world has prepared proper guidelines and geometric design standards in order to minimize conflicts and delays through junction design which is safe.

(i) Road Junction Design

There is no junction design guideline in Punjab for geometric design of different type of junctions. AASHTO guidelines are sometimes referred for junction design in Lahore; these do not consider local traffic mix condition and travel behavior of both NMTs and motorized traffic. There is no analysis tool used by TEPA for such designs except using AutoCAD for preparing sketches which are consider as design. Some local companies are using Road Calc for junction design whereas this software is for rural road design and to estimate cut and fill road alignment etc. Road Calc is not recommended for the urban area junction design and analysis. This is needed to be designed through micro-simulation using specialized software; Paramics, VISSIM, or SIDRA for a single junction. SYNCHRO which is developed for right hand drive traffic, is not compatible with local left hand drive routes and is calibrated with respect to American traffic conditions and travel behavior.

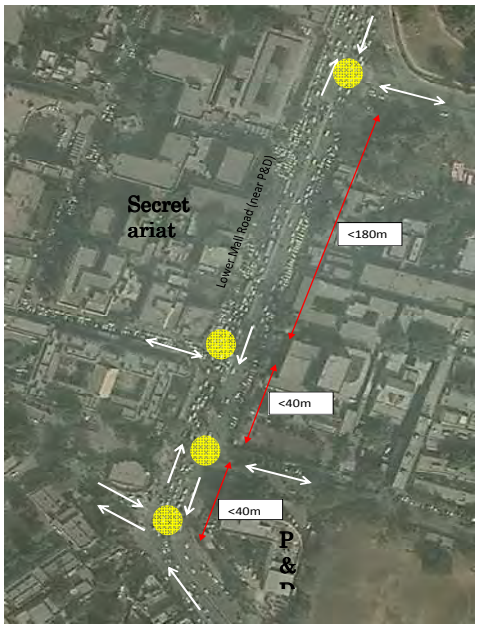
The poor junction design has resulted in complete neglect of safety consideration, cross conflicts, and provision for pedestrians and bicycle at junctions. This causes bottlenecks and junctions gridlocks in peak periods. Existing design is mostly based on perception of TEPA engineers without traffic analysis. Some of the major issues found in junctions are signalized and un-controlled junctions are located within 100m of each other. This causes blocking of traffic due to queues at the upstream junction as shown in Figure 3.4.16.

Flyovers are perceived as an answer to resolve traffic conflicts, instead to improve through simulation and modern safe design. The flyover only solves the flow of single movement and the rest of turning movements remain clogged due to poor junction layout below the flyover as shown in the Figure 3.4.17.

Multi-arm junctions also suffer from poor layout as can be seen at Qartaba Chowk in Figure 3.4.18.

LUTMP junction survey recorded brief characteristics of 264 junctions in the Study Area: out of which 125 were signalized, 22 roundabouts, 14 gyratory, 10 manual control, and 93 uncontrolled. This data can be used for junction improvements.

Figure 3.4.16 Distance between Junctions Less than 100m



Source: JICA Study Team

Figure 3.4.17 Kalma Chowk Flyover and Turning Traffic Below

Source: JICA Study Team

Figure 3.4.18 Poor Junction Layout at Qurtaba Chowk with Conflicts

Source: JICA Study Team

(ii)Traffic Signal Design

Traffic signals are considered to be next best alternative from priority control of junctions once it exceeds certain traffic volume. Unfortunately there is no standard or guidelines available with GoPb for traffic signals system installation warrants, operational control, cycle time calculation, phase split design, and coordination between signalized junctions' network. JICA Study Team has conducted detailed road junctions/ traffic signal operation survey in vicinity of Mall Road, covering a total of 26 junctions out of which 18 junctions are signalized.

All signalized junctions were operational on pre-determined cycle timing; over the day, without any peak period distinction. There is no proper phase splits and cycle time distribution according to traffic volumes, and are based on perception instead of any analytical work.

Each of the signalized intersection is operating in isolation and does not have any coordination or network connectivity with adjacent junctions. There is no controlled system. This results in unnecessary and excessive delays at most junctions to heavy traffic movement and causes long queues as shown in Figure 3.4.19.

Figure 3.4.19 Ferozepur Road – Long and Constant Queue from Ichhra Chowk to Shama Chowk

Source: JICA Study Team

(iii) Adaptive Traffic Control System

Lahore has a total of 134 signalized Junctions out of which 95 traffic signals are compatible with Urban Traffic Control (UTC) system technology and 39 are stand alone non-UTC. The 95 UTC capable signals are compatible with Australian adaptive traffic control system technology known as Sydney Coordinated Adaptive Traffic Control System (SCATS). These can be effectively utilized to establish a centrally controlled system. This would reduce delays up to 20-40%. TEPA has made a coordinated effort with the Urban

Unit to establish such a system by commissioning a consultant, who offered design and build technology based on Split Cycle Offset Optimization Technique (SCOOT). If selected for implementation, all existing signals would have to be removed due to non-compatibility with SCOOT technology. The project in turn collapsed due to large budgetary requirements and lack of technical capacity of TEPA.

(iv) Existing Traffic Signal System Condition

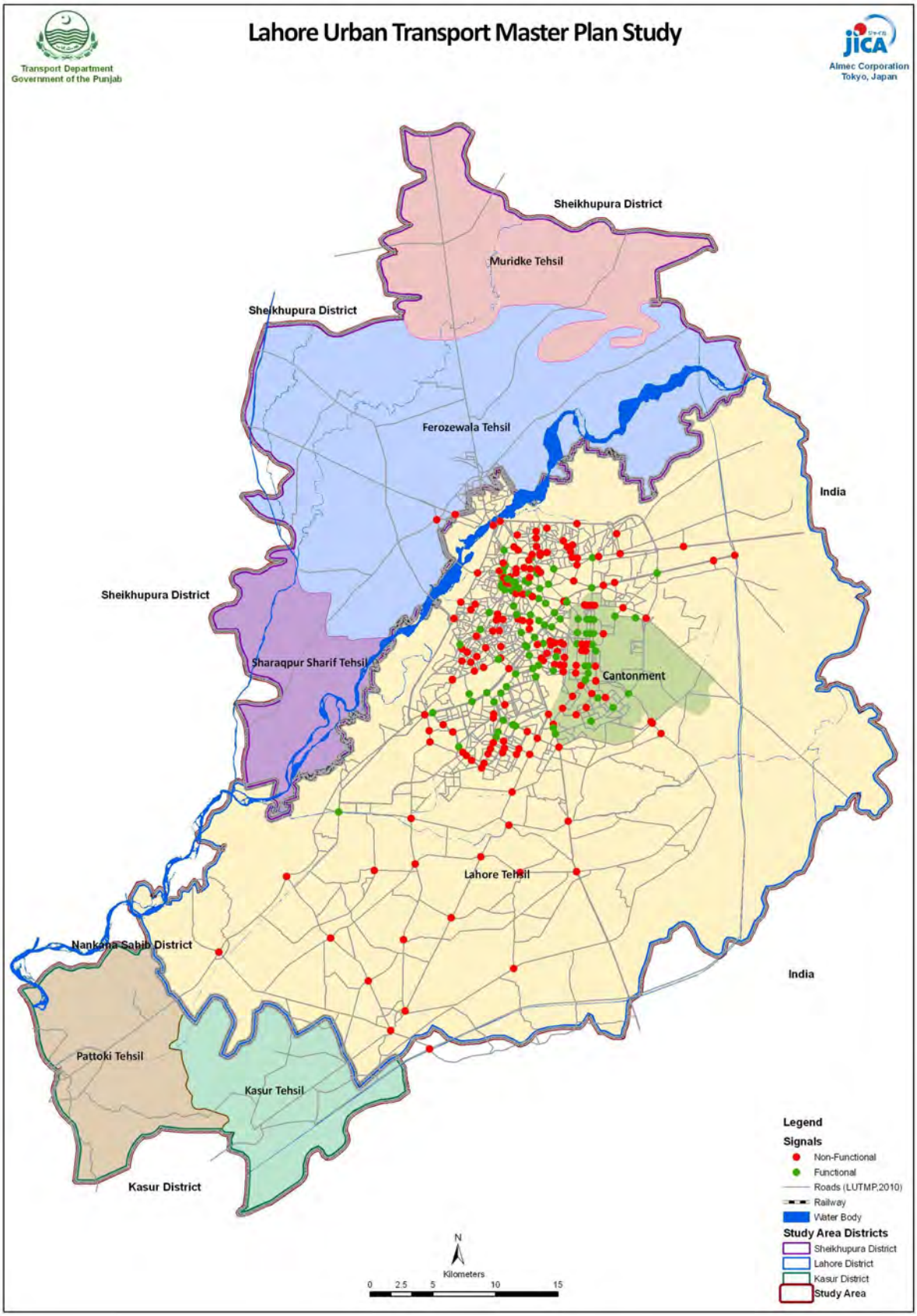
TEPA has installed traffic signals in Lahore which include: pre-timed, semi-actuated, and fully actuated signal systems. All traffic signals in Lahore are operating on pre-timed basis for which timing has never been updated since installation, and operating on similar timings for all traffic movements. No semi or fully actuated traffic signals in Lahore are functional. Various construction activities like road maintenance, installation of different public utilities like gas, landline cables, water and sewerage pipes have severely damaged embedded loops in the roads and these have never been repaired. Further, existing signals are not maintained and their physical condition is deteriorating with time as shown in Figure 3.4.20.

LUTMP conducted road traffic junction survey, and the results are illustrated in Figure 3.4.21. About 60% of the traffic signals were found to be non-functional or were not working at the survey time. LUTMP surveys showed that 70% of the surveyed junctions are not working in morning, afternoon and evening peak periods and were controlled by traffic wardens.

Figure 3.4.20 Traffic Signal Covered by Shop Shade

Source: JICA Study Team

Figure 3.4.21 Working Condition of Traffic Signals in Lahore



Source: JICA Study Team

5) Parking Management

Parking management is one of the most critical issues in the absence of appropriate land use planning and control in each union council level. Commercialization and land use control violation are continuing at full pace, and land use along major and minor roads are in continuous process of being converted from residential to commercial without their traffic impact assessment.

(i) Parking Policy and Existing Legislation

There is no parking policy for Lahore or Punjab for the overall management of parking provision and appropriate parking facilities. This has resulted in complete ignorance for the provision of adequate facilities and managing the parking demand/ supply in the city by the responsible authorities/ agencies. Parking management is not the priority for the authorities, and mostly road space has been continuously encroached by illegal parking in Lahore. This reduces the operational capacity of road due to side friction of parked vehicle and reduced number of lanes available to traffic.

GoPb Ordinance, 2001 defines the responsibility of union councils, towns and district government for planning, managing and control of on and off street parking facilities. However, existing city district government of Lahore has little technical capacity to plan for city wide parking system, and has transferred this responsibility to respective TMAs.

LDA existing by-laws defines the requirement of limited Traffic Impact Assessment (TIA) mostly related to parking requirements for all commercial developments. However, due to lack of technical capacity and ability to fully assess and evaluate, development projects have been approved without full realization of the TIA. This created traffic demand resulting junctions failure, illegal parking along service roads and main carriageways near such commercial areas as shown in Figure 3.4.22.

(ii) Current Parking Facilities

CDGL has provided small scale parking stands along 32 corridors in Lahore for motorcycles and cars. These are ill planned, lack capacity and result in encroaching the service roads and main carriageways. Existing condition of parking stands on Mall Road are shown in Figure 3.4.22 and 3.4.23. There are vague parking design standards/ guidelines for Lahore. Parking facilities are often provided without considering the demand and the impact on junctions, service roads and main carriageways.

Parking was observed in LUTMP road network inventory survey along both sides of roads as shown in Figure 3.4.24, and parking stands provided by CDGL with their capacity is shown in Figure 3.4.25. This clearly shows the neglect Lahore CBD area parking demand around Mall Road in the south and southeast of the Walled City area. There are only three

off-street car parking plazas provided by TEPA; which have about 700 car parking spaces. Total parking spaces provided by both CDGL and TEPA are for 7,200 motorcycles and 2,000 cars. These are insufficient when compared with parking demand in these areas.

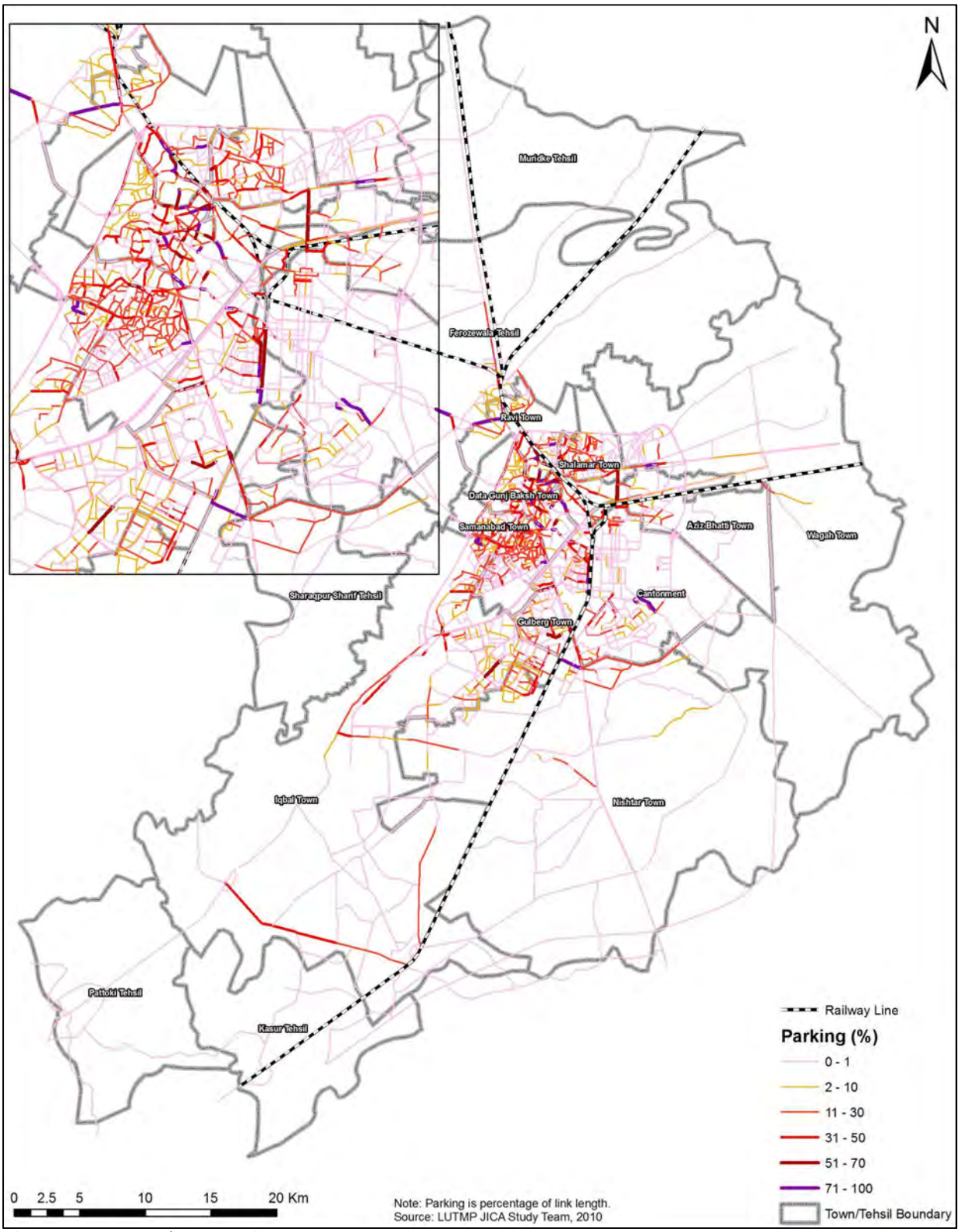
Figure 3.4.22 Parking at Panorama Shopping Center Covering almost Whole Service Road along Mall Road

Source: JICA Study Team

Figure 3.4.23 Parking on Opposite Side of Panorama Shopping Center Blocking Service Road

Source: JICA Study Team

Figure 3.4.24 Distribution of On-Street Parking, 2010



Source: LUTMP Road Inventory Survey